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A SIMPLE HYPOTHESIS WITH REGARD TO THE PARTITION COEFFICIENT EXISTING IN TERNARY LIQUID SYSTEMS.

By ROWLAND MARCUS WOODMAN.

The present paper deals with the distribution of one liquid between two immiscible liquids; the attempts made so far to calculate the distribution coefficient for these systems have been confusing; an effort is made here to bring these systems into line with the partition coefficient existing for a solid solute between two immiscible liquid solvents.

By far the most common examples of these systems are the so-called "partly miscible pairs of liquids." That is to say, when the solute liquid (called by Bancroft[1] the *consolute*) is added to a mixture of two immiscible or partially miscible liquids with both of which it is totally miscible separately, two layers are formed if the consolute is in deficit, but one homogeneous layer if the consolute is in excess. Representation of the results of the analyses of the two layers on triangular graph papers invented by Gibbs,[2] Stokes[2] and Roozeboom,[2] gives binodal curves, the points defining corresponding layers being joined by tie-lines. The critical point on the curve is, in no case known to the author, the maximum of the curve.[3]

For the above reason, the examples discussed will refer to partly miscible pairs, though there is no reason to doubt the validity of the arguments when applied to any liquid system which can be represented by such a binodal curve. Unfortunately, *most liquids are difficult of accurate quantitative estimation* when present in mixtures; consequently, most of the binodal curves are merely "outlined" by variations of the synthetic method,[4] the compositions of the corresponding layers—and hence, necessarily, the ties—being absent from the results (*e.g.*, Schreinemakers,[5] and Schoorl and Regenbogen[5]).

That a partition coefficient does definitely exist where the amount of the common liquid solute is small has been shown in systems where the solute is capable of accurate estimation.[6] Many results, notably those of Herz and co-workers,[7] also

[1] Bancroft, *Physical Review*, 1895, III, 21.

[2] Gibbs, *Trans. Conn. Acad.*, 1876, III, 176; Stokes, *Proc. Roy. Soc.*, 1891, XLIX, 174; Roozeboom, *Zeitschr. physikal. Chem.*, 1894, XV, 147.

[3] Findlay, *Phase Rule*, 1918, 253.

[4] Seidell, *Solubilities*, 1917, 9.

[5] Schoorl and Regenbogen, *Rec. des Trav. Chim. des Pays-Bas*, 1922, XLI, 1; Schreinemakers, *Zeitschr. physikal. Chem.*, 1897, XXIII, 652, *et seq.*

[6] *E.g.*, Rothmund and Wilsmore, *Z. physikal. Chem.*, 1892, XL, 611; Philip and Clark, *J.C.S.*, 1925, CXXVII, 1274.

[7] Herz : see Seidell, *Solubilities*, 1917, 2, *et seq.*

demonstrate that as the total amount of consolute in a system constituting a partly miscible pair is increased, the partition coefficient, defined as the ratio of the concentrations of the consolute in the layers, continuously alters. Moreover, the complex laws of partition[8] do not hold in these cases.

The concentration of the consolute in these systems has been variously expressed, as, gm., gm.-moles, c.c., etc., of consolute, per gm., gm-mole, 100gm., litre, etc., of layer, though the usual representation of analyses of these liquid sytems in triangular diagrams is gm. per 100gm. (weight percentage.) The author, where data is at hand, has calculated the coefficients from simple percentages (*i.e.*, they are the ratio of gm. per 100 c.c. to gm. per 100 c.c.). This brings them into line with the generally-accepted and highly-successful convention regarding the distribution of a solid solute between two immiscible liquids.

The hypothesis favoured in this paper combines some of the points made by Bancroft,[9] Taylor[10] and Waddell,[11] with treatment of both layers. The method of expressing concentrations which they adopt is quite sound, for it avoids complications due to increasing mutual miscibility of the layers as the amount of consolute in the system is increased. This last-mentioned factor, of course, excludes the simple treatment sufficient in the case of distribution of solids, and neglect to take it into account has been the failing-point of many attempts to obtain partition coefficients where the amount of consolute in the system is great.

Instead, however, of expressing the concentrations as immiscible liquids per unit of consolute, they are expressed as consolute per unit of immiscible liquids. If the system be A - S - B, where A and B are the immiscible or partially miscible liquids and S is the consolute, the concentrations are, in the first place, assumed to be gm. of S per gm. of A and of B; and, as the two layers represented by a tie on the diagram are in equilibrium at a given temperature, these two concentrations are assumed to obtain throughout the whole system for that particular mixture and temperature.

To go a step further, it is assumed that when definite amounts of A, S and B are *mixed at some temperature, the mixture* momentarily becomes two liquids—A with a portion of S (liquid X), and B with the remainder of S (liquid Y)—depending for composition on the partition coffiecient of the consolute at that temperature between A and B, and on the amount of consolute present. X and Y, the two liquids so got, being partially miscible because of the presence of S, then mix to give the layers in equilibrium (which are subjected to analysis), without losing, however, their identity. Thus the two concentrations previously mentioned hold throughout the equilibrium, and the method reduces itself to finding the partition coefficient of S between A and B themselves for any two-phase equilibrium; the increasing miscibility of A and B due to increase in the amount of S is thus avoided, and, at the same time, the coefficient is calculated on the same basis as if S were solid, or a liquid in very small quantity, *viz.*, with respect to A and B.

If mathematical expressions for the concentrations can be reached for the different equilibrium mixtures of a system, then a series of partition coefficients is at once obtainable for the whole of the binodal at that temperature. This series will vary internally according to the state of association of the consolute, and, as a whole, according to the definition of the concentrations, which will depend on the available data on the densities of the binary mixtures concerned. The mathematical expressions derived are on the assumption that the curve for a given system has been outlined, and that tie-lines —and hence analyses of the corresponding layers—are available; this limits the tests to which the hypothesis can be put to a few systems.

Let "a" be the concentration gm. of S per gm. of A, and "b" be the concentration gm. of S per gm. of B; let the weight percentages of constituents found by analysis in the layers for a definite mixture of A, S and B at the desired temperature be:

UPPER LAYER.

$$\left.\begin{array}{l} a_1\% \text{ of A} \\ s_1\% \text{ of S} \\ b_1\% \text{ of B} \end{array}\right\} \quad a_1+s_1+b_1=100\text{gm.}$$

---

[8] Nernst, *Theoretical Chemistry* (Eng. Edn.), 1923, 575.

[9] Bancroft, *J. Phys. Chem.*, 1896, I, 34.

[10] Taylor, *J. Phys. Chem.*, 1896, I, 301; I, 461; I, 542.

[11] Waddell, *ibid.*, 1898, II, 233.

LOWER LAYER.

$$\left.\begin{array}{l} a_2\% \text{ of A} \\ s_2\% \text{ of S} \\ b_2\% \text{ of B} \end{array}\right\} a_2+s_2+b_2=100gm.$$

Then, if a and b hold throughout the equilibrium, $aa_1+bb_1=s_1$ and $aa_2+bb_2=s_2$. Solving, for a and b, the expressions

$$a=(s_2b_1-s_1b_2)/(b_1a_2-b_2a_1)$$

and

$$b=(s_1a_2-s_2a_1)/(b_1a_2-b_2a_1)$$

are obtained.

Expressions for the partition coefficent are then given by either the ratio a/b^n or that a^n/b, where n = an integer. The value of n is, of course, determined by the usual method of inspection.

EXPERIMENTAL JUSTIFICATION.

In a previous paper[12] it has been shown that, for the system water-acetic acid-toluene at 25° C., the layers in any equilibrium mixture obey the *Antonow-Reynolds's* rule[13]; this rule states that when two partially miscible liquids are shaken together, the difference in the tensions liquid/air for the saturated phases is equal to the tension at the liquid/liquid interface. Each equilibrium, therefore, may be said to represent the mutually saturated phases of two liquids which have not lost their identity in the mixing. It was shown that the results of the experiment could be explained on the assumption that, on shaking up the three liquids in any proportion, two new and definite liquids, water and acid, and toluene and acid, were momentarily formed, and that these new liquids, being partially miscible to various degrees according to the amount of acid present, mixed to give two saturated phases without loss of identity, *i.e.*, the amounts of acid associated with fixed amounts of water and toluene were regarded, in any particular mixture, as being constant and fixed throughout the equilibrium. This, therefore, gives some experimental justification for the above mathematical treatment.

To be continued.

[12] Woodman, *J. Phys. Chem.*, 1927, xxxi, 1742.

[13] Antonow, *J. Chim. phys.*, 1907, v, 372; Reynolds, *J. C. S.*, 1921, cxix, 466.

A NEW CONCEPTION OF RELATIVE CONFIGURATION.

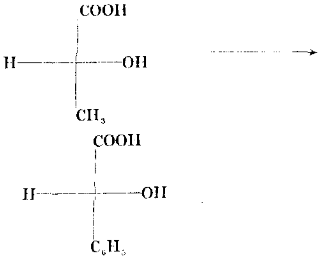
By CHARLES EDMUND WOOD AND SYDNEY DIGGARY NICHOLAS.

(*University of Birmingham.*)

(*Continued from Vol.* cxxxix, *page* 405.)

Levo-rotatory lactic acid is configuratively related to dextro-rotatory tartaric acid.

Recourse to such methods for establishing relative configuration is in many cases not feasible, for example no attempt has ever been made to pass from lactic to mandelic acid owing to experimental difficulties.



What methods then have been resorted to? Such methods are empirical. They are *based on no definite theoretical criterion* but depend upon cumulative comparative data. Consider the cases of the two acids mandelic and hexahydro-mandelic acids.

		$[M]_D$*	
	acid	sodium salt	potassium salt
d(−) lactic acid	−2	+13.2	+13.7
d(−) glyceric acid	−2.3	+20.6	+23.7
d(+) malic acid	+3	+16.2	+15.5
d(+) tartaric acid	+21.3	+59.9	+64.4
d(−) hexahydro-mandelic acid	−21.3	+13.6	
d(−) *mandelic* acid	−240	−179	

The points of interest are: (1) the table is cumulative comparative data; (2) there is a right displacement on passage from the acid to the sodium or potassium salt; (3) mandelic and hexahydro-mandelic acids

* Clough, *Trans.*, 1925, cxxvii, 2808.

are in harmony with the four acids proved by the chemical transformation method, that is, the generic method.

Considering the comparison of the molecular rotations of the methyl esters and amides of these acids (Clough, (*loc. cit.*) it *is to be noted that (1) in every case there is* a right displacement on passage from the methyl ester to the amide, (2) again the two acids under consideration are in harmony with the other four.

	$[M]_D$ methyl ester	amide
d(−) lactic acid	+8.6	+19.6
d(−) glyceric acid	+5.8	+66.2
d(+) malic acid	+11.1	+52.8
d(+) tartaric acid	+3.7	+164
d(−) hexahydro-mandelic acid	−36.8	+65.4
d(−) mandelic acid	−276	−144

Another interesting rule applied to these acids is illustrated by the following table which shows the rotational displacements of the homologous series of normal esters.

Normal Alkyl Ester	$M^{t°}_{D}$ Methyl- CH_3-	Ethyl- C_2H_5-	Propyl- C_3H_7-	Butyl- C_4H_9-	Amyl- C_5H_{11}-	Hexyl- C_6H_{13}-	Heptyl- C_7H_{15}-	Octyl- C_8H_{17}-	Nonyl- C_9H_{19}-	T°C.
*d( ) lactic acid	+8.59	13.37	17.44	19.58	20.16	21.25	21.33	18.91	19.85	20
†d( ) glyceric acid	+5.76	12.30	19.15 (17°)	21.37 (17°)			23.05 (18°)	22.28 (19°)		15
§d(+) malic acid	+11.10[3]	19.34[3]	25.33[3]	26.37[4]						20
‖d(+) tartaric acid	+3.675	16.14[5]	25.74[7]	26.89[7]			31.79[6] (44.5°)	31.87[6] (45°)		20
**d(−) hexahydro-mandelic acid	−36.8	24.4	15.5	15.4	9.7	9.3	9.1	8.2	8.3	30
††d(−) *mandelic* acid	−255.5[1]	210.3[1]	191.3[1]	189.6[2]						45

The above curves have been obtained by arbitrarily joining the rotations of the esters of an homologous series. All curves whether situated in the positive or negative region have a general similar appearance characterised by a marked ascent for the lower esters on passing up the series. In all cases there is a right displacement on passage from the methyl to the ethyl ester, but the displacement is less marked generally on proceeding from the ethyl to the propyl ester.

In general the effect of temperature upon the corresponding individual esters of the acids in the above table is similar, namely with increase of temperature a right rotational displacement takes place. Selecting the butyl ester the rule is indicated below.

Authors.

* Wood, Such and Scarf, (*Trans.*, 1923, CXXIII, 600).

† Frankland and MacGregor, (*Trans.*, 1893, LXIII, 1415).

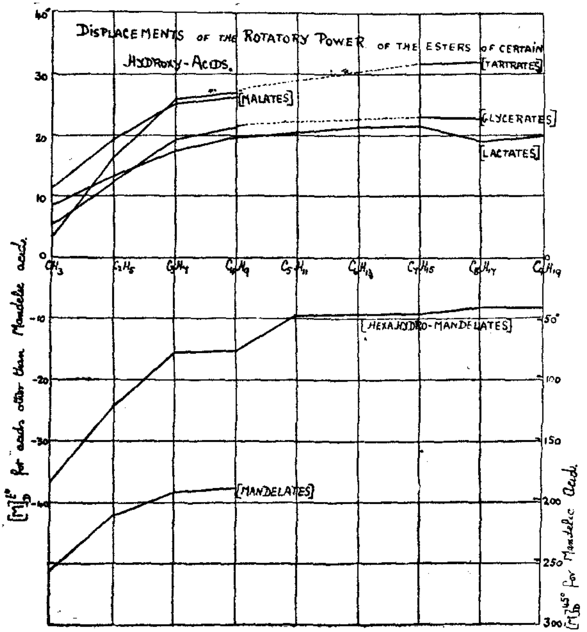
§ [3]Walden (*Z. physikal Chem.*, 1895, XVII, 248).
[4]Auschütz and Reitter, *ibid.*, 1895, XVI, 493.

‖ [5]Wood and Nicholas (*Trans.*, 1928, 1671).
[6]Frankland and Garner, *ibid.*, 1919, CXV, 636).
[7]Austin, *ibid.*, 1928, 1831.

** Wood and Comley (*Trans.*, 1924, CXXV, 2630).

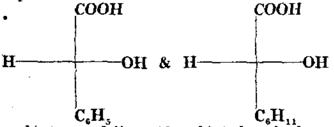
†† [1]Deduced from data given by Walker, *J. physical Chem.*, 1909, XIII, 574).
[2]Wood, Chrisman & Nicholas, (*Trans.*, 1928, 2181).

FIG. 5.



	$[M]_D^{t°}$	
n-butyl lactate " d "	+19.58 (20°)	+29.39 (110°)
n-butyl tartrate " d "	+26.75 (21.5°)	+41.06 (140°)
... n-butyl hexahydromandelate " d "	-15.4 (80°)	-7.8 (140°)
n-butyl malate " d "	-189.5 (45°)	-175.3 (75°)

On these and on analogous grounds the space formulæ



d(-) mandelic acid d(-) hexahydro-mandelic acid

have been assigned and not on chemical transformation methods.

In contrast to the above method, a method having theoretical significance and based on the restriction of the region of anomaly has been noted. *The criteria for the relative configuration of a " d " compound are : for visual anomaly — inflexion and maxima confined to the positive region and crossing of the axis $d\alpha/d\lambda$ positive, for potential anomaly—analysis of the dispersion curve by the Drude equation, the rotational constant of the high frequency term being positive, that of the low frequency term being negative.*

Anomaly of α-hydroxy acids.

	Either simple derivatives of acids show
d( ) lactic acid	anomaly in positive region.
d( ) glyceric acid†	not determined.
d(+) malic acid	anomaly in positive region.
d(+) tartaric acid	anomaly in positive region.
d( ) hexahydro-mandelic acid ..	anomaly in positive region.
d( ) mandelic acid*	does not exhibit visual anomaly.

† No dispersion curves have ever been determined for glyceric acid or its derivatives but if taken would show anomaly.

* Analysis of dispersion curves not determined but they are not simple

The empiric methods mentioned above are by no means without exception consequently controversy occurs at the present time between workers in this field. Taking d(+) malic acid as an example,* passage from the methyl to the ethyl ester takes place with a right rotational displacement but the benzoyl derivatives of these esters, however, show a left displacement.

Benzoyl d-malic acid dimethyl ester [M $^{20°}$D 14.94

Benzoyl d malic acid diethyl ester [M $^{21°}$D 11.38†

Further, certain derivatives of d(+) malic acid show a left displacement and not a right displacement (which is the usual criterion) with increase of temperature (compare the dimethyl and diethyl esters of ethane-sulphonyl l-malic acid, Freudenberg and Noe, *Ber.*, 1925, LVIII, 2404). Such exceptional behaviour is to be expected in the positive region of a " d " enantiomorph on account of possible occurrence of maxima of positive rotation (Wood and Nicholas, *Trans.*, 1928, 1696).

When tested by the criteria of anomaly derivatives of malic acid are not exceptional, for example

Compound (

Methyl " d " malate§ [α]λ +0.79 (red), +0.40 (yellow), 0.00 (green), −0.40 (light blue), −0.79 dark blue).

Benzoyl " d " malic‖ [α]$^{20°}$ +3.82(637)+ 4.22(578) + 4.34(546) + 1.95(436).

(For simplicity of treatment, the acid of relative configuration " d " has been considered.)

Had the empirical methods been proved sound there would not be the present controversy between Clough (*Trans. Chem. Soc.*, 1918 CXIII, 526), Levene and collaborators (Levene, Mori and Mikeska, *J. Biol. Chem.*, 1927, LXXV, 337) on the one hand and Freudenberg and collaborators (*Ber.*, 1927, LX, 2447), Kuhn (Kuhn and Wagner-Jauregg, *Ber.*, 1928, LXI, 505) and Kenyon Phillips and Turley (*Trans. Chem. Soc.*, 1925, CXXVII, 399) on the other concerning the configuration of α-bromo-propionic acid.

(*To be continued.*)

* For other exceptions (Wood, Chrisman and Nicholas, *Trans.*, 1928, 2180.)

† Frankland, *Trans.*, 1899, LXXV, 367.)

§ Grossmann and Landau (*Z. physikal. Chem.*, 1910, LXXV, 144) conc. 2.5 in solvent benzene.

‖ Freudenberg and Noe, *loc. cit.*

WORLD POWER CONFERENCE.

The papers which have been received for the Second World Power Conference, to be held in Berlin, 1930, include fifty from England. These are sponsored by such leading bodies as the Central Electricity Board, the British Electrical and Allied Manufacturing Association, the Institution of Electrical Engineers, the Institution of Mining Engineers, the Institute of Fuel, the Society of British Gas Industries, the Society of Chemical Industries, and others.

The list of authors from whom contributions have been received includes such prominent men as Dr. Rudolf Lessing, one of the best-known experts on coal, E. C. Evens, the Chairman of the Association of English Iron and Steel Manufacturers, Dr. C. H. Lander, the Director of the British Fuel Research Department, C. W. Marshall, of the Central Electricity Board, Sir Charles Parsons, the designer of the Parsons steam turbine bearing his name, and many others

A certain proportion of the papers deals with the utilisation of the solid, liquid and gaseous fuels in power economy. Modern *steam-power plants, considered as the basis* of cheap power development, will also be discussed in this connection, whilst a paper on the subject of water-power works is also anticipated. A large number of the papers is devoted to the problem of the distribution and utilisation of electricity.

The whole of the preliminary work which is being done in England in preparation for the Second World Power Conference is being supervised by D. N. Dunlop, the Chairman of the International Executive Committee of the World Power Conference.

LOW TEMPERATURE CARBONISATION.

THE "K.S.G." PLANT AT THE WORKS OF THE SOUTH METROPOLITAN GAS COMPANY.

By A WELL-KNOWN ENGINEER.

We are now able to give some additional information concerning the standard retirt installation of 80 tons per 24 hours capacity *for the low temperature carbonisation of* coal at the Greenwich Works of the South Metropolitan Gas Company according to the "K.S.G." process. The retort is of the usual design, being a very large rotary, slightly inclined, mechanically continuous, externally heated, steel cylinder 72 feet long and 10 feet diameter, having an inner cylinder 85 feet long and 5 feet 6 inches diameter, which carries the load. The complete weight (empty) *is about 160 tons, the outer drum* being made in three sections, the two end sections being $\frac{7}{8}$inch thick, and the middle hammer welded under water-gas heating and annealed . Also each seam is reinforced by means of outer steel bands, 2 feet 9 inches wide and $\frac{13}{16}$inch thick, rivetted and welded, while the inner drum is on the same lines but much heavier, made of $1\frac{5}{8}$ inch plate.

The small coal enters the retort at one end and travels along the inner cylinder during $1\frac{1}{2}$ hours, being raised to a temperature of 400-570° F. (205-300° C.). After-*wards the charge falls out through small* apertures into the outer cylinder which at this point is the hottest zone (abont 925-1025° F.), and at the same time highly superheated steam at 850-950° F. is blown through the charge at this point to the extent of about 100-200 lbs. per ton of coal, so as to prevent undue expansion of the plastic charge. The low temperature carbonisation is completed in another $1\text{-}1\frac{1}{4}$ hours' travel in the outer cylinder, the temperature slowly declining to about 800-900° F. (430-485° C.) while the speed is *one revolution in 90 seconds.*

Also if necessary a certain amount of the low temperature fuel dust and breeze, not over 10 *per cent.*, is blended in with the raw coal to prevent the plastic charge sticking, while for heating the setting, producer gas is burnt in a small firebrick combustion chamber, and the very hot gases at 2370-3095° F. (1300-1700° C.) diluted not with air, but with about 50 per cent. of the waste combustion gases re-circulated to give approximately 1100-1290° F. (600-700° C.) passed all round the retort.

A noticeable feature of this installation at Greenwich is the complete equipment of pyrometers and other instruments along with different controls to change the rate of feed of the raw coal, the speed of revolution of the retort, the temperatures, the distribution of the heat throughout the length of the retort, and the amount (and temperature) of the superheated steam. Highly interesting also is that the actual degree of expansion of the retort itself, anchored at one end only, is used as an accurate indicate of the *operating conditions. Thus the longitu-*dinal expansion of the outer drum from cold to the correct working temperature is approximately $5\frac{1}{2}$ inches while $3\frac{1}{2}$ inches represents the figure in the case of the inner drum.

The installation also includes a producer gas generator for providing the gas to heat the retort, the exit combustion products passing to a waste heat boiler, which provides sufficient steam for the complete process, including auxiliary steam engines, all exhausting to the retort main, having super-*heaters integral with the setting, while* also a gas engine is provided, and the details of the results being obtained in continuous operation are awaited with great interest.

THE BRITISH DISINFECTANT MANUFACTURERS' ASSOCIATION.

The growing appreciation of the value of trade associations for protecting the interests of their members is exemplified by the formation of a new British Disinfectant Manufacturers' Association, the inaugural meeting of which was held on December 16, 1929, at the rooms of the Chemical Society, Burlington House, Piccadilly, W.1. There was a good attendance, and close on 50 firms representative of all the branches of the disinfectant trade signified their intention of *joining the new Association.*

One of the main objects of the Association is to protect and further the mutual trade interests of its members, to foster the manufacture of British disinfectants and promote closer co-operation between British disinfectant manufacturers. The Association will also serve as a medium for placing before Government Departments or other public bodies, at home and abroad, the views of British disinfectant manufacturers on matters affecting their indnstry. This is a very important function at the present *time when legislation, which may affect* many branches of industry is either in train or threatened.

At the inaugural meeting, the Rules of the new Association were discussed, and adopted. Mr. N. F. Kingzett, of the Sanitas Co., Ltd., was elected Chairman, Mr. W. H.

Hivey of Taylor's Automatic Disinfector, Ltd., Vice-Chairman; and Mr. R. A. Blair, of Burt, Boulton & Haywood, Ltd., Honorary Treasurer. The Association will be affiliated to the Association of British Chemical Manufacturers, 166, Piccadilly, W.1., which will provide the necessary secretarial and other services.

Active endeavours are to be made to secure additional members. Any disinfectant manufacturer, whether individual, firm, or company, operating within the Empire, will be eligible; the subscription of £2 2s. is such that no firm, however small, should be prevented from joining on the score of expense. The new Association has already taken steps to investigate certain questions of tests which have arisen in connection with the standardisation of disinfectant specifications by a Government Committee.

GENERAL NOTES.

CANADA'S RECORD STEEL PRODUCTION.

The Dominion Bureau of Statistics, in its October report on the Canadian Iron and Steel Industry, records a slight falliing-off in pig iron production, but an increase of 17 per cent. in steel manufacture, as compared with the September figure. The total output for the first ten months of 1929 is higher than that for any similar period since 1918.

October production of pig iron totalled 91,409 long tons, as compared with the September figure of 98,816 tons and with the total of 93,186 tons recorded in October, 1928. Cumulative production during the first ten months amounted to 921,096 tons, an increase of 10 per cent. During the month a blast furnace at Sydney, N.S., was banked, there being at the end of the month seven furnaces in blast in Canada with a total capacity of 2,825 long tons per day, being 68 per cent. of the available blast furnace capacity.

The output of steel ingots and direct steel castings in October amounted to 115,674 tons, a gain of 17 per cent. as compared with the September figure and of 6 per cent. as against the total of 108,987 tons reached in October, 1928. Cumulative production of steel to date totals 1,203,625 tons, the highest reported for the first ten months of any year since 1918, and 17 per cent. higher than the 1,028,697 tons produced during the corresponding period a year ago.

ANTI-KNOCK PETROL FROM COAL.

"Every ton of normal British bituminous coal contains approximately eighteen gallons of coal oil and two and a half gallons of motor spirit, and we can no longer afford, as a nation, to allow these to be wasted in the form of smoke," said Mr. J. P. Postlethwaite, Chief Engineer to the Coalite Carbonisation Process in an address delivered before the Cleveland Scientific and Technical Institution.

The modern method of getting coal by means of power-operated cutters produced, said Mr. Postlethwaite, a large percentage of very small coal, known as "fines," for which there had been so poor a market in the past that hundreds of thousands of tons had been shipped abroad at less than cost. It was now possible, however, to turn this small coal into solid smokeless fuel, compadable with the best house coal, but without its smoke. At the Askern Main Colliery there was now installed a Coalite Carbonisation Plant which dealt with 1,750 tons of washed small coal per week, the whole of which was converted into solid smokeless fuel.. The extension of such a process would obviously do much to improve the position of the coal industry.

By using this new method the following products were obtained from a ton of coal:

14 cwts. of coalite.
18 gallons of crude coal oil.
13 lbs. of sulphate of ammonia,
2½ gallons of crude petrol.
4,000 cubic feet of gas at 750 B.Th.U.'s per cubic foot.

The crude spirit, obtained from the gas by the process known as "scrubbing," produced, when refined, a motor spirit of the highest quality, with excellent anti-knock properties. This motor spirit was superior to No. 1 petrol as sold to-day. While only 2½ to 3 gallons of crude petrol was obtained from each ton of coal at present, the 18 gallons of coal oil could also be converted into petrol by separate treatment. For this purpose a new plant, with a capacity of 4,000 barrels per day, was now being erected on the Humber.

The smokeless fuel had the advantage not only of burning clean and clear so as to avoid pollution of the atmosphere, but also of providing heat at an exceptionally low cost. Burned in the ordinary open grate, soild smokeless fuel was much cheaper than gas or electricity as a means of heating rooms. Taking gas at 3s. per 1,000 cubic feet, and electricity at 1d. per unit, it was found that to produce exactly the same unit

of heat the cost was 2s. 5d. with electricity, 7d. with gas, and only 2d. with coalite.

Apart from this very real direct economy to the domestic consumer, Mr. Postlethwaite continued, the low temperature carbonisation process provided a fuel that was smokeless—a great public gain—while at the same time, it would produce, in conjunction with the new refining method, a considerable quantity of British coal petrol to take the place of imported petrol now costing, without the tax, about 19s. a cwt. The new process therefore promised to bring new benefits alike to the mining industry and to the nation as a whole.

OIL SHALE.

Satisfactory progress is being made by Torbanite Products, Limited, in the construction of their plant on the oil shale deposit in McLellan's Brook district, Pictou County.

It is believed that the Province has 10,000,000,000 tons of shale capable of produsing a barrel of oil per ton. The Company named hopes that the gasoline recovered from the shale will be sufficient to defray the cost of operation and that their profits will be derived from the sale of by-products.

BARYTES.

The production of barytes in Canada during 1928 amounted to 127 tons, valued at $2,847, as compared with 56 tons worth $1,268 in 1927. The 1928 production was obtained from the Johnson mine at Lake Ainslie, Inverness County, Nova Scotia. Imports of barytes into Canada during the period under review totalled 2,878 tons valued at $58,710.

BOARD OF TRADE ANNOUNCEMENT.

Key Industries—Zirconium.

A representation has been made to the Board of Trade under Section 10(5) of the Finance Act, 1926, regarding zirconium oxide.

Any communication should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, S.W.1., within one month from the date of this notice.

23 December, 1929.

POSSIBLE CANADIAN PRODUCTION OF RADIUM ORE.

The occurrence of small quantities of radioactive minerals in granite pegmatite dykes in Ontario and Quebec was noted for many years ago, when some of these dykes began to be worked for their mica or feldspar content. A considerable variety of rare-earth minerals, many of them radioactive, have been yielded by such dykes, but not in commercial quantities. Recently, however, prospecting in the Wilberforce districts of Central Ontario has resulted in the discovery of a deposit of uraninite that appears more likely to prove of commercial grade than any hitherto found in Canada.

Uraninite is a crystallised form of pitchblende, the richest commercial ore of radium, and is the mineral now mined at Jachymov, in Czechoslovakia, and in the Belgian Congo. From these deposits the greater part of the world's supply of radium has been obtained.

VISIT OF THE BRITISH COMMERCIAL SECRETARY AT SHANGHAI.

The Department of Overseas Trade announce that Mr. H. J. Brett, C.M.G., the British Commercial Secretary at Shanghai, will be available at the offices of the Department during the period January 16 to 24, to interview manufacturers and merchants interested in the export of British goods to China. He will also visit a number of industrials centres in the Provinces.

Firms desiring interviews with Mr. Brett in London or information regarding his arrangements to visit provincial centres should apply to the Comptroller General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1., quoting the reference 2203/1/29.

VISIT OF THE COMMERCIAL COUNSELLOR AT BUENOS AIRES.

The Department of Overseas Trade announce that Mr. H. O. Chalkley, C.B.E., the Commercial Counsellor to His Majesty's Embassy at Buenos Aires, will be available at the offices of the Department during the periods January 13 to January 17, and February 3 to February 7, to interview manufacturers and merchants interested in the export of British goods to the Argentine Republic. He will also visit a number of industrial centres in the Provinces.

Firms desiring interviews with Mr. Chalkley in London or information regarding his arrangements to visit provincial centres, should apply to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1., quoting the reference 5534/1/29.

OVERSEAS TRADE IN NOVEMBER.

British exports in November were less in value than in the same month, 1928, by £642,000, a substantial gain in respect of raw materials and a smaller one in respect of food, drink, and tobacco being more than outweighed by declines recorded in the manufactured articles class and the other minor classes. The increase of £1,189,000 in the value of coal exported last month, as compared with November, 1928, was due to an advance of 27 per cent. in the total tonnage exported and an advance of about 7 per cent. on the average value per ton attained by the exports of a year ago. In the manufactured articles class, the outstanding changes in November, in relation to the values recorded for the corresponding month of 1928, were decreased exports in the textile groups (principally that comprising cotton yarns and manufactures which showed a decline of £1,878,000) and the vehicle group, and increased exports of non-ferrous metals and manufactures (chiefly tin blocks, etc., which advanced by £496,000), machinery, electrical goods and apparatus, and articles falling within the chemicals group.

The net gain in total imports last month over the value recorded a year ago was £1,396,000. In the food, drink, and tobacco class, imports of grain and flour were greater by £1,166,000; the increase in the value of wheat grain imported amounted to £834,000, the advance being principally due to much larger consignments from Argentina, which more than counterbalanced decreased consignments from the United States and Canada. The increase of £571,000 in the value of meat imports was occasioned by a rise in the average value of these imports, the quantities concerned not differing greatly in the two months under consideration. Substantial decreases, as compared with a year ago, occurred in imports of goods falling within the miscellaneous food groups, the commodities principally affected being tinned salmon and cheese, the imports of which were smaller by £1,311,000 and £411,000 respectively, and eggs not in shell, the imports of which were greater by £659,000. Appreciable decreases were also recorded in respect of tea, unrefined sugar, and currants, and a substantial increase in respect of non-dutiable fruit and nuts. So far as imports of raw materials are concerned, the small increase for the class as a whole, as compared with a year ago, was the net result of increases and decreases in individual groups, some of which were of considerable magnitude. The principal variation was a large decline (£1,966,000) in the total value of raw cotton imported, this being due not only to a decrease in quantity, but also to an appreciable fall in average import values. The average value per cental of sheeps' and lambs' wool was also lower than a year ago, but the increase in the quantity involved was sufficient to raise the total value of raw wool imported some £850,000 above the value recorded in November, 1928. Imports of raw rubber and kindred materials were greater than a year ago by £1,008,000. The increase of £823,000 in imports of manufactured goods last month, as compared with November, 1928, was due to gains in a number of groups, the most prominent of which (one of £496,000 in the manufactured oils group) was principally due to larger imports of refined petroleum at higher average values.

Exports of imported merchandise last month were less than those of a year ago by £2,596,000, the chief declines being registered in the groups comprising non-dutiable food, raw wool, undressed hides and skins, and raw rubber. In most of the groups showing a greater value of re-exports for the month than in November, 1928, the gain was inconsiderable, but re-exports of non-ferrous metals and manufactures thereof were greater than a year ago by £160,000.

The net tonnage of vessels that entered with cargoes, and the net tonnage that cleared with cargoes, at ports of the United Kingdom in November was 6.7 per cent. greater than in the corresponding month a year ago.

Although exports of coal fell below the total recorded for October, they were greater by 1,163,000 tons than the exports in November, 1928. Conspicuous increases occurred in consignments to France and Belgium as compared with a year ago (541,000 tons and 208,000 tons respectively), and Italy, the Netherlands, Germany, and the Scandinavian countries all took appreciably more than in November, 1928. The average price last month remained at the level attained in October, namely, 16s. 7d. a ton, thus being substantially higher than the average price of 15s. 6d. a ton recorded a year ago. It will be noted that both the coal and the fuel oil shipped in November for the use of steamers engaged in the foreign trade (and fishing vessels) were smaller in quantity than the amounts so shipped in either of the earlier months shown in the table.

Although imports of crude petroleum in

November were much larger than in November, 1928, the total quantity imported during the expired eleven months of the year (453.4 million gallons) does not differ appreciably from the quantity exported in the corresponding perior of 1928. Exports of British-refined petroleum were 13.0 million gallons in November, 10.4 million gallons in October and 11.8 million gallons a year ago, the principal changes as compared with November, 1928, being an increase in exports of gas oil and a decrease in exports of motor spirit.

NEW STEEL INDUSTRY AT CALGARY.

The Manitoba Rolling Mills Company has begun the manufacture of steel at its new plant at Calgary, Alberta, steel being poured from the 25-ton open-hearth furnace at the rate of 70 tons of ingots daily. The plant has been erected at a cost of $600,000 on an 18-acre site on which the buildings cover an area of 2 acres. The rolling mill department began operations on January 1.

An interesting feature of the new industry is the use of natural gas as the heating element, thus providing an outlet for some proportion of the enormous surplus of gas available in the Turner Valley oil field. The consumption of natural gas will be approximately 1,500,000 cubic feet per day after January 1, this, however, being only a minor percentage of the quantity available; much less, in fact, than the output of many individual wells. Electric motors have been installed with a total installation of 2,900 h.p.

Some 65 men were employed from the start of the operations, and this number may be increased to 140 in January. The plant will produce industrial rails up to 40 pounds per yard, open hearth reinforcing steel, merchant bars, angles, railway spikes, tieplates and rail joints.

THE CRYOSCOPY OF SULPHUR.

In the November issue of the *Bulletin* of the Japanese Chemical Society, C. R. Platzmann describes experiments made to find the cryoscopic constant, K, for sulphur (m.p., 114.5° C.) By dissolving a whole series of organic and inorganic compounds in molten sulphur the value K=213 was obtained. It was found that arsenic trisulphide had the formula As_2S_3 in dilute solutions, but was polymerised in strong solutions. Selenium tetrachoride showed only half its normal molecular weight since it reacted in molten sulphur, giving the dichloride and sulphur dichloride.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

HARRISON MEMORIAL PRIZE.

The Harrison Memorial Prize Selection Committee, consisting of the President of The Chemical Society (Professor J. F. Thorpe, C.B.E., D.Sc., F.R.S.), The Institute of Chemistry of Great Britain and Ireland (Professor Arthur Smithells, C.M.G., D.Sc., F.R.S.), The Society of Chemical Industry (Dr. Herbert Levinstein), and The Pharmaceutical Society (Mr. L. Moreton Parry), has awarded the Harrison Memorial Prize for 1929 to Dr. Reginald Patrick Linstead.

The prize is given for conspicuous meritorious work in any branch of chemistry, pure or applied, and is to be regarded as an exceptional distinction to commemorate an exceptional man and to be conferred upon the young chemist under 30 years of age who in the opinion of those best qualified to judge has made a notable addition to our knowledge of chemistry.

The presentation of the prize will be made at the Annual General Meeting of the Chemical Society, Burlington House, Piccadilly, W.1., on Thursday, March 27, 1930, at 4 p.m.

THE OPTICAL SOCIETY.

The following papers were read at a meeting held at the Imperial College of Science and Technology, on Thursday, December 12, 1929 the President, Mr. F. Twyman, F.R.S., in the chair :—

The Insensitivity and Personal Equation Errors of Optical Settings. By J. GUILD, A.R.C.Sc., F.Inst.P., of the National Physical Laboratory.

The paper contains the results of observations on the insensitivity, that is mean difference of the individual observations of a large series from the mean of the series, in the case of X type graticles set on vertical object lines. The influence of the following factors were investigated. (1) Thickness of Cross Wires; (2) Angle between Cross Wires; (3) Field Brightness; (4) Pupillary aperture.

Observations were also made of the "personal equation" error in such settings. The best thickness of wire is that which subtends at the eye between 60 and 90 seconds of arc. The insensitivity is least when the angle between the cross wires is about 45°. The insensitivity is practically

independent of ordinary illumination and pupillary aperture from .5 m.m. upwards. Mr. Rheinberg, Captain Baker, Major Henrici, and Messrs. T. Smith, Underhill, Whitwell and the President joined in the discussion.

The following apparatus was exhibited and demonstrated :—

(*a*) Adam Hilger, Ltd. : " Cylindrical mirror corrected to give freedom from aberation in the formation of an image of a distant line when the angle of incidence is 45°." Mr. Underhill described the apparatus and showed how a templet for grinding the mirror was made.

(*b*) Mr. Clifford Brown : " Duschrome Sight Test." The apparatus is a substitute for the Snallen Chart. The subject comgreen illuminated grounds and enables the sight tester to add + or - lenses in the trial frame till both lines are equally distinct when the correcting lens for the mean ray can be prescribed. Similarly sets of radiating lines of black on red and green illuminated grounds enable the axes of an astigmatic eye to be determined after which the correcting powers of each meridian can be found as above.

(*c*) C. W. Dixey and Sons : " The Maddox Cheiroscope." Mr. S. Adams described and showed four types of this instrument for use in the treatment of squinter's acquired Amblyopia and for the improvement of the correlation between hand and and eye.

THE GEOLOGICAL SOCIETY.

December 4, 1929, Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the chair.

A number of Fellows were elected.

The following communications were read :—

Foliation in its Relation to Folding in the Mona Complex at Rhoscolyn (Anglesey). By Edward Greenly, D.Sc., V.P.G.S.

Further studies on the major anticline of Rhoscolyn have thrown much light on successive stages of the metamorphism.

The major, minor, and minimum foldings (with their thrustings) have each given rise to a foliation; that produced by the major folding being, on the nearly horizontal core of the great anticline, conspicuously transverse to the bedding of the massive grits of the South Stack Series. Yet it is thrown into isoclines by the minor folding, which is therefore subsequent to it. Where the cross-foliation of the major folding has been isoclinally folded, the foliation of the minimum folding runs right up to it at any angle without being itself folded in the least, whence it follows that the minimum is later than the minor structure. Thus the three foliations (major, minor, and minimum) developed in chronological order.

Thrusts often truncate the minor isoclines, and any decapitated anticlines where the beds are steep the beds above and below the thrust have been made to interdigitate. Sometimes this is carried so far as to drive long wedges of thin grits in between the laminæ of the major cross-foliation. In this manner the structures usually found at a thrust-plane have often been completely obliterated, even when the thrust is considerable.

The relations of major to minor folding furnish an explanation of the fact that the major cross-foliation, unlike a slaty cleavage, fails to traverse the pelitic beds. The foliation of the plutonic intrusions, and the tremolite-schists, are products of the major movements.

In ' The Geology of Anglesey ' the principal metamorphism was ascribed to the major and subsequent movements. Re-examination has shown, on the contrary, that this metamorphism is independent of, and older than, all three. Its foliation is developed along innumerable thrusts, but these are at angles so acute to the bedding that, especially when thrown into rapid isoclines, they easily escape notice. This is the true explanation of ' *monoplanic schists.*'

The view now abandoned was based upon the aureoles of the basic intrusions, but a fresh study has revealed that their evidence gives decisive confirmation of the view now adopted. They are frequently cut by thrusts of the major series, but are never affected by the principal metamorphism. There are several lines of evidence, perhaps the most striking being the fact that the thermal minerals of the aureoles crystallise *across and obliterate* the planes of the principal metamorphism, which is, therefore, anterior to the intrusions and thus to the major folding.

This early foliation is really the regional metamorphism. But the thrusting to which it is due, unlike those of the three later series, can be referred to no visible folding. Accordingly, its disentanglement goes to confirm the hypothesis that recumbent folding exists, and is the dominant structure of the Mona Complex.

These studies, carried out only on a single tectonic horizon, greatly extend the chronology of the metamorphism of the Mona Complex.

DISCUSSION.

The President congratulated the Author on his interpretation of some of the apparently contradictory structures in these crushed and mangled rocks; the structures are familiar among the less 'competent' of pre-Palæozoic schists and besides great mineral lodes. He congratulated him also on bringing Anglesey into line with other areas where it had heen found that the highly metamorphosed rocks were the oldest, in correction of first impressions to the contrary. This change of view had happened in the North-West Highlands of Scotland, and had been proved by Mr. G. Barrow in the South-East Highlands. Some of the features described by the Author amounted to a kind of sedimentary lit-par-lit structure.

Dr. E. W. Shaw remarked that the paper was of very great interest because, in several parts of the world, he had encountered structures that seemed to be similar to those described, but had been unable todecipher their meaning. He was not sure that the features that he had seen were closely similar; wut, at least, they involved greater deformation of higher beds than of lower ones, and he had presumed, in several cases, that the phenomena had resulted through the 'rubbing-up' of a weak member by an overthrust mass that had since been removed by erosion. The paper furnished strong evidence that painstaking, orderly, and detailed field observation of all features that might prove pertinent, together with a check against the principles of mechanics, might lead to an understanding of a class of structural features which may be common but, like many other geolovical phenomena, have been passed over because not understood.

The Author welcomed the statement made by the previous speaker that similar structures are to be seen in several parts of the world, for it confirmed the hope that a study of the Mona Complex might furnish us with principles of wide application. He desired once more to urge that, although the phenomena of the regional foliation lend support to the theory of recumbent folding, it is still prudent to regard that theory as no more than a working hypothesis.

The Avonian Succession in the South of the Isle of Man. By HERBERT PRICE LEWIS, M.A., F.G.S.

The rocks described occupy a 'key' position in relation to Carboniferous rocks of the Irish Sea area. They lie within a basin, which is partly tectonic, between the Port St. Mary-Arbory Fault on the north-west, and the line of the Langness Ridge on the south-east.

The succession is of interest, in that it unites the lower part of the sequence established in the North-Western Carboniferous Province with the upper part of the succession recently worked out in the Middle Province.

The age of the Basement Conglomerate is probably near that of the Brownber Pebble-Bed, and much earlier than that of the Peel Sandstones and Conglomerate, which, if we may judge from their garnet-rich heavy mineral content, are of Upper Avonian or Upper Carboniferous age. The Lower Grey and Dark Limestones are of similar facies, aud contain essentially the same fauna as the *Michelinia-grandis* and *Productus-corrugato-hemisphericus* Zones of the North-Western Province (from the *Camarophoria-isorhyncha* sub-zone upwards). As in the lower beds, a shallow-water facies dominates throughout the Upper Grey and Dark Limestones, of which the lower portion at Strandhall is faunistically the equivalent of beds of Lower *Dibunophyllum* age in the North-Western and Northern Provinces. The upper portion, at Strandhall, Scarlett, and Castletown, is almost identical in fauna and lithology with the uppermost Lower *Dibunophyllum* Beds (or D_1-D_2 passage-beds) at the northern margin of the Midland Province.

Of the Poyllvaaish Limestones, the lower beds with Beyrichoceratids are referable to the 'Cracoean' division (B) of Bisat; while the Upper Knoll Limestone, containing *Goniatites crenistria* in abundance and *Dibunophyllum* cf. *muirheadi* with other D_2 Clisiophyllids near the base, is the Manx representative of the lowest division of the 'Bollandian' (P_{1a}).

Near the bottom of the dark *Posidonomys-becheri Beds*, which contain a goniatite-fauna typical of the Lower Bowland Shale (P_{1b}), is intercalated a *Cyathaxonia-Emmonsia* fauna of Upper D_2 phase, similar to that at the top of the Derbyshire Limestone. The junction between the *Posidonomya* Beds and the Scarlett volcanic tuffs is a disturbed one, but some limestones appear to have been interbedded with the lowest tuffs before movement occurred.

The Manx sequence is compared with that of other Carboniferous rocks surrounding the Irish Sea. Several corals, including some species new to science, are described and faunal lists are given.

An interesting discussion followed, in

which the President, Prof. E. J. Garwood, Dr. E. Neaverson, Dr. J. Wilfrid Jackson, Mr. R. G. S. Hudson, and Drs. E. Greenly and A. Wilmore took part.

NOTICES OF BOOKS.

Grundzüge der theoretischen und angewandten Elektrochemie. By DR. G. GRUBE. Second Edition. Pp. xii + 495. Dresden & Leipzig: Theodor Steinkopff. 1929. Price 28 marks.

Prof. Grube's comprehensive treatise is one of the most important of the recent works on Electrochemistry and its technical applications. The first edition, which appeared in 1922, was issued in two parts, but these have been combined (although amplified) in the new edition.

After a general introduction on electrical phenomena the author deals with Faraday's Laws and their applications and with the ionic theory and the conductivity of electrolytes. Considerable attention is paid to the production of electric energy, its storage and its distribution and uses.

Then follows an account of electrode potential, electro-metallurgical processes, electrolysis, oxidation and reduction processes and the technical application of all these in industrial production. Nevertheless it would still appear that the author is not entirely conversant with at least one other successful arc process used for many years now in Great Britain beyond those he describes in the last chapter.

Electrochemical methods have firmly established themselves in the chemical industries and Prof. Grube's authoritative work will commend itself to chemists and technologists in England and on the continent.

The Scientists' Diary and Year Book, 1930.

Messrs. James Woolley, Sons & Co., Ltd., of 76, Deansgate, Manchester, have issued a handsome Pocket Year Book and Diary which contains a large number of interesting scientific facts and formulæ which will be found very useful for ready reference by those fortunate enough to possess a copy.

INVESTIGATION OF FUELS AND FUEL TESTING.

There has just appeared a review of the work carried out in 1927 at the Canadian Deptartment of Mines on Fuels and their use. The investigations which are being undertaken by this body include carbonisation tests at both high and low temperatures and the examination of Canadian bituminous fuels, oil shale, etc. The first part of the present review is taken up with an account of the *Use of Gas and By-Product Cokes for Domestic Heating Purposes*, by E. S. MALLOCK AND C. E. BALTZER. Among the other contributions are, *Coking Tests of Coals from Western Canada*, by R. E. GILMORE and R. A. STRONG; *Low Temperature Carbonisation*, by R. A. STRONG; and *the Analysis of Solid Fuels* (compiled by J. H. H. NICHOLLS).

The Second section of this work deals with a survey of the use of Gasoline (By P. V. Rosewarne and R. J. Offord), and an account of the methods of Assaying Bituminous Sands (by R. E. Gilmore, A. A. Swinnerton and G. P. Connell).

The review is very comprehensive, covering, with the index, over 100 pages, and it will be of special interest to fuel technologists.

CORRESPONDENCE.

(*To the Editor of* THE CHEMICAL NEWS.)

Dear Sir,—Reading up the back files of *The Chemical News*, I am struck with the occasional appearance of matters relating to thermo-chemical data.

As far back as about 1910 Sir William Crookes did not wish to print further theoretical papers by me, the series ending the non-metallic elements, except, I think selenium and tellurium. At that time he also suggested the importance of the experimental determination of such heat equivalents as I called attention to, and although I may at the time have formed some idea of the possibility of such, I did not pursue the subject further.

Yours faithfully,
J. C. THOMLINSON, B.Sc.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Wednesday, January 8, at 8 p.m.—(Ordinary Meeting.) Shaw Desmond "The Novel—What It Is and What It Is Not." P. Morley Horder, F.S.A., a Vice-President of the Society will preside.

Friday, January 10, at 4.30 p.m.—(Indian Meeting). Sir Basil P. Blackett, K.C.B., K.C.S.I.: "The Economic Progress of India." The Most Hon. the Marquess of Reading, P.C., G.C.B., G.C.S.I., G.C.I.E., G.C.V.O., will preside.

CITY OF LONDON.

THE SIR JOHN CASS TECHNICAL INSTITUTE.

Jewry Street, Aldgate, E.C.3.

Principal : GEO. PATCHIN, A.R.S.M., M.I.M.M.

The following special Evening Courses will be given during the Second Term (January to April, 1930) :—

COLLOIDS
By E. HATSCHEK, F.Inst.P.
Fridays, from 8 to 9.30 p.m., commencing January 10, 1930.

LAW AND INDUSTRY
By G. S. W. MARLOW, B.Sc., F.I.C.
Tuesdays, from 7 to 8 p.m., commencing January 14, 1930.

TECHNICAL GAS ANALYSIS
By N. F. GOODWAY, M.Sc., A.I.C.
Tuesdays, from 7 to 10 p.m., commencing January 14, 1930.

NOTICE TO AUTHORS AND CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

37,531.—Caro, N., and Frank, A. R.—Preparation of concentrated nitric acid. December 6.

37,187.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of halogenated dibenzopyrene-quinones. December 4.

37,483.—I. G. Farbenindustrie Akt.-Ges. — Manufacture of halogenated 4 : 5 : 8 : 9 dibenzo pyrene-3 : 10-quinones. December 6.

37,520.—Lutz, G.—Carrying out gaseous chemical reactions. December 6.

Specifications Published.

322,209.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges.) — Manufacture and production of azine derivatives.

296,730.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of white titanic acid.

322,253.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges). — Manufacture and production of 2-alkylbenzanthrones.

Abstract Published.

320,606.—Acetic and other aliphatic acids. — British Celanese, Ltd., 22, Hanover Square, London, and Billing, J., of British Celanese, Spondon, near Derby.

Acetic and like aliphatic acids are extracted from their aqueous solutions by means of solvents in two or more stages, the solvents being so chosen that in each stage the ratio of acid to water in the extract is greater than in the preceding stage. The invention is described with reference to acetic acid, the concentration being effected in two stages, the first stage yielding an acid of 50-70 per cent. strength and the second a highly concentrated acid. The first stage may be effected with ether, ethyl acetate, ether containing 20-30 per cent. of petroleum ether, or ether or ethyl acetate admixed with hydrocarbons or halogenated hydrocarbons such as methylene chloride or carbon tetrachloride as described in Specification 283,702; the extract is distilled, and the acid is then treated with another solvent, such as petroleum ether, benzene, a mixture of ether and petroleum ether containing 30-50 per cent. petroleum ether, or chlorinated hydrocarbons such as methylene chloride, ethylidene chloride, trichlorethylene or carbon tetrachloride, alone or mixed with other solvents such as ether or ethyl acetate, and particularly in the last stage the solvent is preferably one which will form an azeotropic mixture with water, so that in the subsequent distillation the water will be removed with the solvent. In the second or subsequent stages the extraction may be effected only so for as to leave appreciable quanti-

ties of acid in the treated liquor, which liquor is then returned to the first stage. The extraction may be effected by mixing and allowing to separate into layers, or by counter-current in a column or by passing the vapour of the solvent or of the ingredients of a mixed solvent into an extraction tower or column, and the heat of the vapours of the solvent coming from the still may be used to preheat the extract on its way to the still. In examples (1) acetic acid of 15-30 per cent is extracted with ether in counter-current, and the extract is distilled, the 70 per cent. acid resulting therefrom being extracted with methylene chloride, yielding finally an acid of 97-98 per cent and a liquor of 30 per cent. which is returned to the first stage; (2) the same dilute acid is concentrated by the first stage as above described, and the 70 per cent. acid is treated with a mixture of 2 volumes ether and 1 volume of petroleum ether.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His

PAVERIN.

507,321.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. — The Firm trading as E. Merck, Frankfurterstrasse 250, Darmstadt, Germany. December 11.

MASA.

506,168.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—European & General Finance Corporation, Ltd., 82, King William Street, London, E.C.4. December 11.

SEROPAN.

507,617.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—I. G. Farbenindustrie Aktiengesellschaft, Mainzer-Landstrasse 28, Frankfort-on-Main, Germany. December 11.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

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By N. F. GOODWAY, M.Sc., A.I.C.
Tuesdays, from 7 to 10 p.m., commencing January 14, 1930.

A SIMPLE HYPOTHESIS WITH REGARD TO THE PARTITION COEFFICIENT EXISTING IN TERNARY LIQUID SYSTEMS.

By ROWLAND MARCUS WOODMAN.

DISCUSSION AND NOTES ON TABLES OF EXAMPLES GIVEN.

It will be seen that the preceding hypothesis amounts merely to the fact that the consolute is regarded as being attached to or dissolved by the other two immiscible liquids, in all cases, as if the two solutions formed (depending in composition on the partition coefficient of the consolute between the initially immiscible liquids and on the amount of consolute present), did not intermingle. The mathematical treatment thus corrects the intermingling which actually does occur, and brings these systems into line with the distribution of a solid, (and of a consolute in small amounts), where the resulting solutions have no tendency to miscibility and where the partition coefficient is, therefore, got from the concentrations of the solute in the layers themselves.

The species of molecules present in the system must, on this hypothesis, as in the case of a solid solute, be the same as in binary mixtures of consolute and initially immiscible solvents. The failure of many authors to obtain even the semblance of a partition coefficient—except where the consolute is limited in amount—by calculating

from the concentrations of consolutes in the layers themselves in ternary liquid systems, is thus apparent; for the two initially immiscible liquids are present in both layers, and the species of molecules of the solute existing in both separate liquids will be mixed in the layers, no definite species preponderating.

The factors of association for various liquids in miscible liquids have been shown by Rózsa[14] to vary greatly and continuously with change of concentration. The present series of partition coefficients, therefore, cannot be constant over a very long range; they will, as shown generally by the tables, vary continuously in one direction in passing down a column. This natural variation is broken only when a definite constant emerges from the column, the constant usually being at or near a distinct break; the constants also vary irregularly, as if by error of experiment.

After such a definite constant, the partition coefficient in that column again commences to vary regularly; the probable reason is as follows: a constant can exist only in a column—say the c_5^2/c_6 column of the tables—when the consolute is mainly bimolecular in one of the constituents of the system and unimolecular in the other at the given concentrations c_6 and c_5. As the concentrations, and therefore the association factors, are constantly changing in passing down a column, this range where the molecules are mainly of one variety in each solvent is soon left, and the regular alteration in the coefficient recommences. These varying coefficients are thus equally as natural and as instructive as the constants themselves in studying the state of association of the consolute.

The main purpose of distribution experiments is to gain knowledge of the molecular state of the solute in different solvents. It is, thus, like begging the question to correct the values in a column by factors of association got by some other method. Nevertheless, this would throw considerable light on the problem in these systems—much more than can be got by mere comparison of results. The author, unfortunately, can find only one series of association factors over a wide range of concentration for a set of binary mixtures occurring in these tables, *viz.*, for acetic acid-benzene mixtures in the system acetic acid-water-benzene. The constant, varying by six per cent. in the c_5^2/c_6 column, shows the acid to be mainly dimolecular in benzene over a wide range; this agrees with Rózsa's data for the association factors over the same range of concentration. Moreover, on correcting for the single molecules present, the constant varies only by 4 per cent.; this would be good agreement even for a solid solute.

Occasionally, in the tables, two or three adjacent values in a column show remarkable constancy, and it might be thought that these represent the constant for that column. Inspection shows that these are due to the differences in concentration being too small; they are of value as a kind of duplicate or triplicate experiment showing that the experimental work is accurate, but do not point to a definite species of molecule mainly present. Thus this type of constant is often repeated in the next columns, and seriously interferes with the choice of constants for those columns.

Arrangement of Tables.

The first column gives the number of the tie in the triangular diagram; the second column "m" is the weight percentage of consolute in the aqueous layer of the equilibrium, given so that reference to the authors' results may be made; c_1 and c_2 are the number of gm. of consolute associated with one gm. of water and one gm. of the other liquid respectively, as found by the mathematical treatment; these are used instead of the former signs "a" and "b."

$100c_3$ and $100c_4$ are the weight percentages of consolute (gm. per 100 gm. of binary mixture) in consolute-water and consolute-third liquid mixtures respectively as calculated from the corresponding values c_1 and c_2.

$100c_5$ and $100c_6$ are the corresponding percentages (gm. per 100 c.c. of binary mixture) corresponding to $100c_3$ and $100c_4$, calculated by the aid of the densities of the binary mixtures (d_4 and d_3) found in the literature.

The calculated columns are given in the form c_1/c_2, etc., and not $c_1/\sqrt{c_2}$; the results are thus spread out farther, enabling a more certain choice of constant to be made between the columns.

[14] Rózsa, *Z. Elektrochem.*, 1911, XVII, 934.

SYSTEM WATER-ACETIC ACID-BENZENE AT 25° C. :

No. of Tie	m.	c_1	c_2	$100c_3$	d_1	$100c_4$	d_2	$100c_5$	$100c_6$
1	9.4	0.09399	0.004602	8.592	1.009	0.4581	0.8742	8.666	0.4005
2	16.5	.1984	.01305	16.55	.019	1.288	.8750	16.86	1.127
3	28.2	.3954	.03145	28.33	.034	3.049	.8772	29.29	2.675
4	37.7	.6125	.05339	37.97	.045	5.069	.8795	39.68	4.458
5	43.9	.8023	.07263	44.53	.049	6.770	.8811	46.71	5.965
6	48.3	.9649	.09126	49.10	.053	8.364	.8829	51.70	7.384
7	49.5	.9951	.09348	49.87	.053	8.549	.8831	52.52	7.550
8	53.2	1.200	.1111	54.55	.056	9.997	.8849	57.61	8.847
9	61.4	.856	.1788	64.98	.062	15.17	.8911	69.01	13.52
10	64.5	2.367	.2458	70.30	.064	19.73	.8968	74.78	17.70
11	65.0	.495	.2636	71.39	.064	20.58	.8982	75.95	18.74
12	66.0	3.021	.3570	75.13	.065	26.31	.9053	80.00	23.81
13	65.0	.385	.3786	77.18	.065	27.46	.9069	82.19	24.90
14	60.0	4.183	.4817	80.71	.066	32.51	.9138	86.04	29.71

No. of Tie	c_5/c_6 $\times 10$	c_5^2/c_6 $\times 10^2$	c_5^3/c_6 $\times 10^2$	c_5^4/c_6 $\times 10^2$	c_5^5/c_6 $\times 10^2$	x	$100c_7$	c_5^2/c_7 $\times 10^2$
1	216	188	16	1	0	1.735	0.3394	221
2	150	252	43	7	1	.754	.9694	293
3	110	321	94	28	8	.796	2.370	362
4	89	353	140	56	22	.846	4.086	385
5	78	367	171	80	37	.893	5.627	388
6	70	362	187	97	50	.942	7.164	373
7	70	365	192	101	53	.947	.343	376
8	65	375	216	125	72	.983	8.772	378
9	51	352	243	168	116			
10	42	316	236	177	132			
11	41	308	234.	178	135			
12	34	269	215	172	138			
13	33	271	223	183	151			
14	29	249	214	185	159			

System[15] *water-acetic acid-benzene at 25° C.* : The concentrations are too great to show simple partition.

Results 4-9 inclusive give a constant (6 per cent. variation), for c_5^2/c_6, showing that mainly double molecules of acid are present in the benzene over a wide range, and agreeing with the association factors (x) for the acid in benzene as found by Rózsa; the corrected results[16], c_5/c_7, show a better constant (4 per cent. variation), over the range.

Results 9-11, c_5^3/c_6, show triple molecules are present in benzene (4 per cent. variation), whilst 13 and 14, for widely-different concentrations, indicate the presence of tetramolecular acid in benzene. The next regular column excludes the possibility of more complex molecules.

[15] Waddell, *J. Phys. Chem.*, 1898, II, 233; densities of binary mixtures interpolated from Woodman, *Chem. News*, 1927, cxxxiv, 36; association factors from Rózsa, *loc. cit.*

[16] Assuming single and double molecules only present at the same time, results corrected by $c_7 = 2c_6(x-1)/x$, where x = association factor, c_6 = total per cent. concentration, and c_7 = per cent. concentration of double molecules.

SYSTEM WATER-ACETIC ACID-TOLUENE AT 25° C. :

No. of Tie	m.	c_1	c_2	$100c_3$	d_1	$100c_4$	d_2	$100c_5$	$100c_6$
1	21.38	0.2727	0.01385	21.42	1.026	1.366	0.8613	21.98	1.177
2	30.87	.4483	.02832	30.96	.038	2.755	.8630	32.13	2.378
3	37.69	.6084	.04171	37.83	.044	4.008	.8643	39.49	3.460
4	47.50	.9168	.06674	47.84	.052	6.256	.8674	50.32	5.426
5	58.05	1.444	.1125	59.09	.060	10.11	.8730	62.63	8.824
6	62.53	.781	.1441	64.06	.062	12.60	.8760	68.03	11.04
7	64.86	2.004	.1692	66.71	.063	14.47	.8788	70.91	12.72
8	67.70	.409	.2075	70.68	.064	17.19	.8822	75.19	15.17
9	69.71	.787	.2445	73.60	.065	19.65	.8852	78.38	17.40
10	70.55	3.034	.2941	75.21	.065	22.73	.8903	80.09	20.23
11	69.85	4.840	.3778	82.87	.066	27.42	.8972	88.33	24.60
12	69.40	.900	.4256	83.05	.066	29.86	.9008	88.51	26.89
13	66.68	5.255	.4614	84.03	.066	31.57	.9035	89.56	28.52
14	65.31	.238	.5060	88.97	.066	33.60	.9065	89.50	30.64
15	60.54	.512	.5295	84.65	.066	34.62	.9078	90.22	31.44
16	58.46	.627	.5285	84.89	.066	34.58	.9078	90.48	31.39

No. of Tie	$c_5/c_6 \times 10$	$c_5^2/c_6 \times 10^2$	$c_5^3/c_6 \times 10^2$	$c^4/c_6 \times 10^2$	$c_5^5/c_6 \times 10^2$	$c_6^2/c_5 \times 10^3$	$c_6^3/c_5 \times 10^4$
1	187	411	90	16	4	1	0
2	135	434	140	45	14	2	0.4
3	114	451	178	70	28	3	1
4	93	467	235	118	60	6	3
5	71	445	278	174	109	12	11
6	62	420	285	194	132	18	20
7	56	395	280	199	141	23	29
8	50	373	280	211	159	31	46
9	45	353	277	217	170	39	67
10	40	317	254	203	163	51	103
11	36	317	280	248	219	69	168
12	33	291	258	228	202	82	220
13	31	281	252	226	202	91	260
14	29	263	235	211	189	104	316
15	29	259	234	211	190	110	344
16	29	261	236	214	193	109	342

System[17] *water-acetic acid-toluene at* 25° C. : There is too much acid present in all cases to show simple partition; 1-3, c_6^2/c_6, with a 9 per cent. variation, indicate the possibility of many double molecules of acid in toluene, and very likely represent the transition to triple molecules.

Results 5-11 inclusive — excluding 10, which seems to be incorrect, judging from the behaviour in this and other columns—give a good constant, of variation 3 per cent., indicating triple molecules of acid in the toluene over a very wide range of concentration.

14, 15 and 16 represent close concentrations giving a fictitious constant repeated in various columns, obscuring the choice of further constants to some extent; th should be grouped together as one.

Fairly good constants (8 and 6 per ce variations), are obtained for results 12 16 in the next two columns, pointing that tetra- and pentamolecular acid present in the toluene. The last two c umns merely show that there is no tenden to association in the water.

[17] Woodman, *J. Phys. Chem.*, 1926, x 1283; densities from Woodman, *Che News*, 1927, cxxxiv, 36; the weight p centages of water and toluene are re off from the ends of the ties of the angular diagram, and hence may ca some inaccuracies.

WATER—ALCOHOL—ETHER AT 25° C. (Horiba, *loc. cit.*).

No. of Tie	m.	c_1	c_2	$100c_3$	d_1	$100c_4$	d_2	$100c_5$	$100c_6$	c_5/c_6 $\times 10^2$	c_5^2/c_6 $\times 10^3$	c_5^3/c_6 $\times 10^1$	c_5^4/c_6 $\times 10^4$
1	3.3	0.03534	0.01593	3.414	0.9908	1.569	0.7092	3.383	1.113	304	103	35	1
2	8.0	0.06781	0.03280	6.352	0.9855	3.177	0.7108	6.259	2.258	277	174	109	7
3	10.6	0.1242	0.04834	11.05	0.9793	4.612	0.7125	10.81	3.286	329	356	386	42
4	13.6	0.1643	0.08127	14.11	0.9750	7.516	0.7156	13.76	5.379	256	352	484	67
5	14.5	0.1773	0.08904	15.06	0.9735	8.175	0.7163	14.66	5.854	250	367	538	79
6	16.0	0.1984	0.1153	16.55	0.9713	10.34	0.7185	16.07	7.429	216	348	559	90
7	18.5	0.2371	0.1620	19.17	0.9673	13.94	0.7220	18.54	10.07	184	341	633	117
8	19.9	0.2565	0.1910	20.42	0.9656	16 03	0.7238	19.72	11.61	170	335	660	130
9	21.9	0.2881	0.2335	22.37	0.9630	18.93	0.7265	21.54	13.76	157	337	726	156
10	23.9	0.3150	0.3094	23.95	0.9605	23.63	0.7307	23.01	17.27	133	307	705	162
11	25.5	0.3386	0.3523	25.29	0.9585	26.10	0.7327	24.24	19.13	127	307	745	181
12	27.3	0.3603	0.4104	26.50	0.9526	29.10	0.7350	25.23	21.39	118	298	751	190
13	27.8	0.3652	0.4219	26.75	0.9508	29.67	0.7356	25.43	21.83	117	296	754	192
14	28.2	0.3635	0.4410	26.67	0.9496	30.60	0.7364	25.32	22.53	112	285	721	183

System[18] *water-alcohol-ether at* 25° *C.*: The consolute, in all cases, is present in too great an amount to give simple partition, though there is an indication that the first three values of c_5/c_6 represent a transition range, as they show a maximum before the continuous decrease commences.

Results 6-9 inclusive over a fairly wide range of concentration show a constant (4 per cent. variation), indicating mainly double molecules of alcohol in ether; this "irregular" constant comes between two regular series. Results 10 and 11 coincide, possibly from experimental error, whilst 12, 13 and 14 give a fictitious constant in all columns because of closeness of concentrations, obscuring the choice of further constants.

9 to 14 (constant varying by 6.5 per cent.), indicate probably the presence of triple molecules of alcohol in the ether; judging by the regular increase in the next column up to result 13, the presence of many more complicated molecules is improbable.

[18] Horiba, *Mem. Coll. Sci. Eng. Kyoto*, 1911, III, 63; alcohol-water densities from Horiba, *J. Tok. Chem. Soc.*, 1910, XXXI, 92; those of alcohol-ether from Baker, *J. C. S.*, 1912, *CI*, 1411.

SYSTEM WATER-ACETIC ACID-CHLOROFORM AT 18° C.:

No. of Tie	m.	c_1	c_2	$100c_3$	$100c_4$	c_3/c_4 $\times 100$	c/c_4 $\times 100$	c_3^3/c_4 $\times 10^3$	c_3^4/c_4 $\times 10^3$
1	6.46	0.06963	0.01007	6.509	0.9974	653	42	28	2
2	17.69	.2170	.03761	17.83	3.625	492	88	157	28
3	25.10	.3396	.06864	25.35	6.422	395	100	254	64
4	27.73	.3915	.08364	28.14	7.718	365	103	289	81
5	33.71	.5272	.1190	34.53	10.63	325	112	387	134
6	44.12	.8790	.1964	46.78	16.43	285	133	624	292
7	49.36	1.216	.2625	54.87	20.79	264	145	794	436
8	50.18	1.319	.2897	56.90	22.46	253	144	820	467
9	50.56	1.449	.2997	59.16	23.05	257	152	898	531
10	49.41	1.629	.3193	61.97	24.19	256	159	984	610
11	47.87	1.636	.3398	62.05	25.36	245	152	942	585

System[19] *water-acetic acid-chloroform at* 18° *C.*: (These results are severely criticised[20] by Taylor). The amounts of acid present are too great to show the simple partition law. For 7-11 inclusive there are 8 and 10 per cent. variations in c_4/c_4 and c_3^2/c_4; other columns show no constants; as, if simple partition were illustrated by 7-11, the smaller concentrations would also show this, the second constant must be the correct one, the acid being dimolecular in the chloroform. Expression of the concentrations as percentages (gm. per 100 c.c. of binary mixture), instead of as wt. percents., would possibly straighten out the results, particularly in view of the density of chloroform.

[19] Wright, Thompson and Leon, *Proc. Roy. Soc.*, 1891, XLIX, 174; Wright, *Proc. Roy. Soc.*, 1891, L, 372. No densities available at 18° C.

[20] Taylor, *J. Phys. Chem.*, 1896, I, 542.

SYSTEM WATER-PYRIDI NE-BENZENE AT 25° C. :

No. of Tie	m.	c_1	c_2	$100c_3$	d_1	$100c_4$	d_2	$100c_5$	$100c_6$
1	1.17	0.01184	0.03433	1.170	0.9973	3.329	0.8772	1.167	2.920
2	3.55	.03681	.1104	3.551	.9978	9.938	.8838	3.543	8.784
3	7.39	.07980	.2287	7.391	.9985	18.61	.8928	7.379	16.62
4	13.46	.1549	.3748	13.42	.9997	27.27	.9019	13.41	24.59
5	22.78	.2948	.4634	22.77	1.0012	31.66	.9065	22.79	28.69
6	32.15	.4706	.5235	32.00	.0022	34.37	.9098	32.06	31.25
7	42.47	.7454	.5732	42.71	.0031	36.42	.9115	42.83	33.21
8	48.87	.9833	.6272	49.58	.0032	38.55	.9137	49.73	35.22
9	49.82	1.029	.6115	50.72	.0032	37.95	.9131	50.88	34.65
10	56.05	.709	.7340	63.10	.0025	42.34	.9178	63.24	38.86

No. of Tie	$c_6/c_5 \times 10^2$	$c_6^2/c_5 \times 10^3$	$c_6^3/c_5 \times 10^4$	$c_6^4/c_5 \times 10^1$	$c_6^5/c_6 \times 10^6$	$c_5^2/c_6 \times 10^3$	$c_5^3/c_6 \times 10^3$
1	250	73	21	1	0	5	0
2	248	218	191	17	15	14	1
3	225	374	622	103	172	33	2
4	183	451	1109	273	670	73	10
5	126	361	1036	298	854	181	41
6	97	305	952	297	929	329	105
7	78	257	855	284	943	552	237
8	71	250	879	309	1090	702	349
9	68	236	818	283	982	747	380
10	61	239	928	361	1403	1029	651

System[21] *water-pyridine-benzene at* 25° *C.*: The effect of non-mixing of the benzene and the water is seen here when the amount of pyridine is small, m being practically identical with $100c_3$ over a wide range (the agreement is not quite so good in the case of $100c_4$ and the acid in the benzene layer[21], as the benzene shows greater miscibility with the water, than water with benzene).

The first two results illustrate the simple law of partition and, because of the non-intermingling of the water and benzene, the ratios of pyridine in the benzene *layer* to that in the water *layer* also show this agreement.[21]

The last two columns show that the pyridine is not more complex in the benzene than the water; the reverse seems to hold for this system, and might account for the change in the direction of slope[21] of the ties, and the ascendency gained by $100c_5$ over $100c_6$ with increase in the amount of pyridine (probably this behaviour is due to the constitution of pyridine).

Results 7-10, 7-10 and 5-9 inclusive for c_6^2/c_5 and c_6^3/c_5, c_6^4/c_5 show constants with variations of 8.5, 12, and 8.5 per cent. respectively, proving the pyridine to be more complex in water than benzene. It is difficult to argue more from the results, for it is conceivable that the consolnte is also associated in the henzene--an *inert* solvent; no definite constants over wide ranges might appear if this were so, though better agreement might be expected in the earlier even columns, as a c_6^4/c_5^2 constant would also be a c_6^2/c_5 constant.

SUMMARY.

A simple hypothesis of the partition coefficients existing in systems known as partly miscible pairs of liquids has been developed; the systems are thereby brought into line with the distribution of solids between immiscible liquids, a mathematical correction being made for the increased miscibility of the initially immiscible liquids on addition of consolute. Application of this hypothesis has been made to available cases.

School of Agriculture,
Cambridge University,
England.

[21] Woodman and Corbet, *J. C. S.*, 1925, CXXVII, 2461; the pyridine-water densities are from Jones and Speakman, *J. A. C. S.*, 1921, XLIII, 1867, and the pyridine-benzene densities from Woodman, *Chem., News.*, 1927, CXXXIV, 36. In this latter paper, the pyridine-benzene densities have been, by error, labelled " pyridine-water mixtures."

MATTER AND LOGIC.

By Dr. W. Tombrock.

A Few Remarks.

Preston : *Theory of Light*, 4th ed., p. 21 : "In conclusion, we may state that we believe an ingenious exponent of the emission theory, by suitably framing his fundamental postulates, might fairly meet all the objections that have been raised against it. It will be found, however, on an examination of the whole, that these necessary postulates endow the corpuscles with the periodic characteristics of a wave motion, and when this is introduced the corpuscles themselves may be eliminated ,for the wave motion alone sufficiently explains the phenomena."

Certainly no one can put forward this expression of opinion of the celebrated authority on the theory of light *nowadays* to our disadvantage. We point out, however, a fundamental difference : *our* emitted *light* electrons produce *secondarily* movements in the ether which simulate the results of the undulation theory—*our electrons cannot be eliminated for this reason.*

An English physicist was so good as to write to me as follows :—

"The vortex theory of the atom was originally due to Lord Kelvin" and further :—

"You have *frequently* insisted in your articles that force as such does not exist. This idea of the non-existence of forces as such is one of the teachings of the *generalised* theory of relativity. According to it one body apparently attracts another and draws it towards itself because the presence of the two bodies has modified the geometry of the space around them and each now follows a geodesic or "shortest" line in the new curved space." Similarly Einstein has recently attempted to bring into the theory electrical actions as well, other investigators having previously tried to do so with but moderate success."

Our standpoint with regard to this was : The manifestations of gravitation and similar phenomena are to be attributed to the action of *protons*, whereby in the cyclonic motion the particles in general *lose translational* motion and *gain rotational motion. Through this is produced a relatively* increasing pressure of the surrounding particles by which protons and proton-complexes are driven in the direction of the *least resistance.*

Bergen op Zoom,
Holland.
January, 1930.

SILICOSIS IN MINES.

Conditions in British Collieries and Rand Deep Levels.

In discussing a paper on the above subject (as reported in the *Journal of the Chemical, Metallurgical and Mining Society of South Africa*), Mr. E. C. Ranson said :—

After a number of years of colliery experience in England I was surprised to find that wet bulb temperatures approaching 90° F. were frequently being encountered. It would have been interesting to know the dry bulb readings in such cases. A number of collieries in Great Britain are naturally wet and will have a relatively low wet bulb depression although, broadly speaking, dry conditions prevail—the floor of the working places usually being dry and dusty. When one considers the amount of work a native can perform in these mines with a wet bulb approaching 90° F. and the strenuous work of a collier "scalloping" and filling at the coal face under a similar wet bulb temperature this either points to a comparatively low relative humidity in the coal mine; adequate sustenance during the working shift; an overwhelming proof of the efficacy of acclimatisation; or possibly a combination of all three factors.

Building Up the Resistance of the Worker to Fatigue.

A well-established fact and a point emphasised by Dr. Haldane is the serious lowering of resistance to fatigue by the loss of body salt during sweating. This is a matter which possibly does not receive the attention it deserves on the deep and hot mines of the Rand. A layman would, no doubt, be amazed at the size of the water bottle which some British miners carry with them underground; he needs it to quench his thirst, to replace the water which he is constantly losing by sweating and, if salt is added, to sustain him against fatigue. The ability to see the shift through and the amount of work performed would be much impaired if ample drinking water was not available.

The drinking water system on Rand mines is fairly elaborate—a supply being available on every level. Unfortunately, "boys" doing the strenuous work of shovelling or "lashing" are usually far removed from the drinking water supply and in many cases may work right through the shift without water. In hot moist atmospheres one can conceive the deleterious effect of this condition. It may have considerable bearing on the few cases of "heat stroke" or "physical exhaustion" experienced in

some of our deep level mines. After all, the human machine is the same as any other piece of mechanism unless it is suitably lubricated and attended to it will refuse to function. On one mine, to my knowledge, the practice has been in vogue for some time of providing saline drinking water at working points. A tank of suitable size mounted on four wheels is charged each day and run in to vantage points on the various levels. Ten grammes (or 0.4 oz.) of salt is added to a gallon of water and flavoured with sufficient essence of lime juice to make it palatable. From these tanks "boys" carry supplies in suitable tins to others engaged in "lashing" and other work in the stopes. It might also be mentioned that on this same mine every "lashing," tramming and stoping machine "bay" is supplied with a ration of bread and meat during the working shift—a procedure, no doubt, the management find very beneficial. The provision of saline drinking water to labourers working in hot places is, undoubtedly sound practice.

GENERAL NOTES.

SCIENCE TO SAVE PEOPLE FROM WAR AND STARVATION.

According to Dr. Robert A. Millikan, in his Presidential Address at New York, before the American Association for the Advancement of Science at Desmoines, Science is destined to save the world from war and its future inhabitants from starvation. He defended science against the charges that it was materialistic and had enormously multiplied the tools of destruction.

Every scientific advance, he said finds ten times as many new peaceful and constructive uses as it finds destructive ones. Explosives and fertilisers were basically the same, and even explosives find a dozen peaceful uses to one warlike one. Steel makes bayonets, but it also makes ploughshares, railways, motor-cars, and a thousand other things whose uses constitute the energies from the destructive to the peaceful strongest existing diversion of human energies from the destructive to the peaceful arts.

War, he said, would disappear, like the dinosaur, when and only when the conditions which have given it a survival value have disappeared, and those conditions are disappearing now, primarily because of the changes in the world situation being brought about by the growth of modern science. Dr. Millikan dissented from the view of Professor Soddy that science was on the point of letting loose enormous charges of sub-atomic energy. It was highly improbable, he said, that there was any appreciable amount of available sub-atomic energy. The Creator had put some fool-proof elements into His handiwork and man was powerless, in any case to do it any titanic physical damage.

The present-day worship of the bizarre and of the new, because it is new, was to be deplored. Science was in part responsible for it, for the existing spirit of revolt was, in part, an inevitable reflex of the rapid changes taking place in our time because of the rapid growth of science. In Dr. Millikan's opinion, however, this is nothing to be greatly disturbed about, for there is constantly developing a better understanding of these changes.

COMMERCIAL DIPLOMATIC POSTS IN RUSSIA.

On the resumption of diplomatic relations with the Soviet Union it has been decided to reestablish commercial diplomatic posts which were terminated on the suspension of diplomatic relations in 1927.

The Department of Overseas Trade now *notifies that a Commercial Secretary,* First Grade, with *local rank of Commercial* Counsellor, and a Commercial Secretary, third Grade, will be stationed at Moscow. The senior post will be filled by the appointment of Mr. G. P. Paton, C.B.E., H.M. Consul at Tamsui, Formosa, and the junior post by the appointment of Mr. S. Simmonds, Vice-Consul at Constantza, Roumania. It is anticipated that these officers will take up duty at Moscow during January or early February.

Mr. Paton entered the Consular Service in 1906, when he was appointed a Student Interpreter in Japan. He served at various posts in the Japan Consular Service until 1920, when he was placed in charge of the Consulate at Vladivostock, and in 1921 was promoted to be Consul. He remained at Vladivostock until the suspension of diplomatic relations in June, 1927, and has since served at various posts in Japan.

Mr. Simmonds was appointed a probationer Vice-Consul in the Levant Consular Service in November, 1922. He served at various posts in Morocco, and was appointed Vice-Consul at Constantza (Roumania) in September, 1928.

BRITISH INDUSTRIES FAIR.

Advance Catalogue Heralds Britain's 1930 Trade Push.

A special advance overseas edition of the catalogues of the 1930 British Industries Fair, to be opened in London and Birmingham on 17th February, is already available seven weeks before the opening of the Fair, and is being issued immediately to 10,000 business men in Europe, North America, South Africa and the eastern coast of South America, including all those buyers who have notified the Department of Overseas Trade of their intention to attend the Fair. By this publishing feat, which has only been made possible owing to the keenness of British manufacturers to participate in the Fair, trade buyers in cities as far apart as Istanbul, Capetown, and Vancouver will be able to receive copies of the Fair catalogues before commencing their voyage to England. The catalogues, apart from containing descriptive entries of the exhibits of some 1800 British manufacturers, embody a complete classification of the exhibits by trades, and indexes in nine languages, enabling foreign buyers who are ignorant of the English language easily to trace the goods in which they are particularly interested.

£512,000 BRITISH WHALE CATCH.

A catch of whales producing 122,925 barrels of oil, valued at over £512,000, and 19,900 bags of guano, is reported for the first 10 weeks of the 1929 Antarctic season, ended December 29, by Anglo-Norwegian Holdings, Ltd., the largest British unit in the whaling industry, for the fleets it controls. During the same period last year 91,080 barrels of oil, valued at £378,000, were produced, and 19,000 bags of guano.

NEW CAPITAL ISSUES IN 1929.

Statistics compiled by the Midland Bank, Limited, show issues of new capital in the United Kingdom last year to have amounted to £253,749,000, compared with £362,519,000 in the previous year and £314,714,000 in 1927. The total for December was only £5,283,000, against £24,697,000 and £26,362,000 respectively in the same month of the two preceding years.

THE CHEMIST AS A PROFESSIONAL MAN.

At the Annual Meeting of Irish Free State section of the Institute of Chemistry, Mr. R. L. Collett gave an address on "The Chemist as a Professional Man."

He dealt principally with the personal aspects of the profession, and the relationship which existed between members of the Institute engaged in various types of work. The visits of the officers of the Institute to Local Sections were made chiefly in order that they might have opportunities of learning the special needs of members in different localities. He wished to convey to the Irish Free State Section the thanks of the Institute as a whole for its part in the work of enabling the community to realise the importance of the profession, and he assured the Section that the Institute was at all times eager to assist them in every way possible.

Mr. J. W. Parkes, in proposing a vote of thanks to Mr. Collett, expressed his appreciation of the human touch underlying Mr. Collett's address. While listening to this, he could not help drawing a comparison between the address and the rather stolid *Journal* which members received periodically. He felt that it was a real advantage for members to meet officers of the Institute personally.

Mr. B. G. Fagan seconded the vote of thanks, and said that he was glad to hear of the ways in which the Institute could be of such use to individual members.

Professor F. E. Hackett, speaking as a visitor, and as one outside the chemical profession, said that a chemist seemed to him to be on a similar footing to the engineer in industry. He felt that a chemist should be something more than a chemist, that is, a human being with personal interests outside his profession. Barristers and medical men dealt directly with the public, the chemist directly with industry.

The Chairman conveyed the thanks of the meeting to Mr. Collett, and stated that he had listened with the greatest appreciation to to his remarks and to those of the other speakers. He felt that it was right that the younger members should be able to look for help in their difficulties to the older members of the profession.

In reply, Mr. Collett thanked the members present for their kindly appreciation of his remarks. He suggested to Mr. Parkes that it was much easier to speak to the members personally in a friendly and unofficial manner than to convey the same ideas in cold print in a *Journal*. He would

like again to assure the members that the Institute could be very helpful to them in providing advice and information on special subjects.

Dr. A. G. G. Leonard, Hon. Secretary of the Section, gave a demonstration on glass-blowing to the Engineering and Scientific Association on 9 December. The demonstration was well attended by members of the Association and of the Local Section of the Institute, and included joining tubes, in the forms commonly occurring in chemical apparatus, blowing bulbs, spinning glass tubing, and making vacuum vessels.

Dr. Leonard emphasised the importance of glass blowing to research students in chemistry and physics.

BUSINESS AGENTS IN SCANDINAVIAN COUNTRIES.

Attention has been drawn on previous occasions to the undesirability of United Kingdom manufacturers endeavouring to do business in Norway, Sweden and Denmark through an agent who is not domiciled in the particular country in which business is being sought; and the Commercial Diplomatic Officers in these countries have frequently pointed out that orders are often lost to firms who arrange their business in this manner.

The Commercial Counsellor at Stockholm has once more drawn the attention of the Department of Overseas Trade to the matter. He points out that the cost involved in the appointment of an independent agent in Sweden is comparatively small, a statement which also applies to Norway and Denmark.

FLOTATION IN MINES.

A new, third edition of *The Trend of Flotation* has just been issued as the October *Quarterly* of the Colorado School of Mines. It is a revision and enlargement of the pamphlet on flotation compiled by Arthur J. Weinig, Director, Experimental Ore Dressing and Metallurgical Plant, and Irving A. Palmer, Professor of Metallurgy, and of which the second edition was published in April, 1928. The latter edition, of 5,000 copies, was exhausted in a few months, and a continued demand for information in regard to the progress of flotation seemed to warrant the preparation of a new revision.

The pamphlet under review contains 152 pages, about 65 per cent. more than were included in the previous editions. An attempt has been made to give a fairly complete outline of the modern theory and practice of flotation, as applied in the United States, Canada and Mexico. The section on theoretical considerations has been extended and in part rewritten. There are brief descriptions of the flotation practice at more than thirty concentrating mills, among the latter being a number of the largest plants in the world. The various tables that constituted such an important feature of the first and second editions have been revised and enlarged when considered necessary. There is a very complete bibliography of the flotation literature that has appeared since January 1, 1921.

A new feature is the inclusion of a number of formulæ and diagrams in regard to mill operation and control, prepared by Mr. Weinig and taken from a series of articles recently published in the Colorado School of Mines Magazine. Much of this material is original with the author, and has been declared to be of great value by several well-known mill men.

The Trend of Flotation has been referred to many times as being the best compilation in existence on the theory and practice of flotation. In the present revision the compilers have endeavoured to make it more worthy of that distinction. Price 25 cents.

Proceedings and Notices of Societies

THE PHYSICAL SOCIETY.

November 22, 1929.

Heaviside's Operational Method. By D. P. DALZELL, International Standard Electric Corporation, European Engineering Department, Development and Research Laboratories, Hendon.

The author described a method of treatment of Heaviside's operational calculus which incorporates the views of the late T. J. I'A. Bromwich with those of J. R. Carson. The author's method was identical with that advocated by Van der Pol. In contrast with the procedure recently recommended by W. E. Sumpner, it involved unrestricted use of complex integration as employed by Bromwich, and thus avoids such uncertainties as arise from the use of operators denoted by incomplete symbols.

The author's conclusion is that the theory of integration provides a complete explanation of all the aspects of Heaviside's method of solving differential equations.

The Dynamical Theory of Resonators. By E. T. Hanson, B.A., The Admiralty Research Laboratory.

It is well known that the theory of the small resonator provided with a neck communicating with the open air depends upon the assumption that the air within the neck may be treated as an incompressible fluid. In the present paper the theory is extended to include generally necks of variably cross-section. Again, Rayleigh develops three theories depending upon the assumptions made as to the velocity-distribution of the air at the open end of a resonator. It is shown that his theory, which assumes a variable velocity-distribution over the open end, is erroneous, and a theory which appears to be correct is put forward. The theory of the neck of variable cross-section is applied to the Helmholtz resonator. The theory of an open end of rectangular cross-section is considered. The general theory of resonators is dealt with. It is shown that impedance principles require modification for certain types of resonator, although they hold for most of the common types.

Escapement Errors of Pendulum Clocks. By E. C. Atkinson, M.A.

Prof. R. A. Sampson's theory of maintenance was applied to find equations for the errors of rate caused by changes in intensity and limits of the impulse and in friction of moving parts of the impulse mechanism. As an example, the equations are worked out for the Cottingham clock and applied to find best working conditions. Rigidity of the stops limiting the impulse is found to be the most important point in designing this type. The equations are also given for the dead beat escapement and show that working conditions which are good so far as friction is concerned are bad for barometric changes. The method used for computing " remote " error in these cases must be modified when the inertia of the impulse mechanism is appreciable as in the Shortt clock. The further remote escapement errors due to changes in amplitude introduced by variation of temperature and density of the air are the same as those produced by changes in escapement but are associated with different direct errors which are excluded from this paper.

A Model Four-Wheeled Vehicle Caused to Skid by the Application of the Brakes. By J. Bradby, B.A., The National Physical Laboratory.

The model used for the demonstration had rubber-tyred wheels 4 in. in diameter and fitted with independent brakes. It could be projected along the floor by a simple form of catapult and any desired combination of brakes could be applied. It was shown that the model tended to turn round when the back wheels were locked, but continued in a straight line if the front wheels or all four wheels were locked. This effect was also illustrated with other small models projected by hand along the table. One of these models was arranged to show how in the case of a back-wheel skid the driver could avoid turning round by holding his front wheels parallel to the direction of travel of the centre of gravity of the car.

THE GEOLOGICAL SOCIETY.

December 18, 1929.

The Geology of the Shiant Isles. By Frederick Walker, M.A., Ph.D., D.Sc. Communicated by Alfred Harker, M.A., LL.D., F.R.S.

The Shiant Isles form a small uninhabited archipelago in the North Minch, some 5 miles east of the Park district of Lewis. The group is made up almost entirely of crinanite sills separated by relatively thin argillaceous strata which have undergone considerable contact-alteration, but the fossil content of which (ammonites, belemnites, and one species of *Inoceramus*) assigns them to a low position in the Upper Lias. The two largest islands are each over a mile in length, and are joined by a shingle-beach. Their principal feature is a crinanite sill at least 500 feet thick, with a picrite base. The transition between the crinanite and the picrite is gradual, and the ultrabasic rock is considered to have accumulated by the gravitational settling of olivine-crystals, this hypothesis being borne out by a series of chemical analyses, modes, and specific gravities. Numerous veins of teschenitic and syenitis composition pierce the picrite, and probably represent the expulsion of residual magma at various stages during crystallisation.

A third large island lies about a mile to the east of the other two, and is also to a great extent made up of a single thick sill of crinanite. East of this island, however, the crinanite passes gradually into syenite, towards the centre of the sill, the thickness of the alkaline rock being at least 60 feet. The syenite carries abundant analcite and occasional nepheline, but otherwise resembles closel ythe rock of Gamhnach Mor in Mull. It is riddled by veins of still more alkaline material, and cut by horizontal sheets of olivine-basalt which are chilled against it. The alkaline centre of the sill

is thought to have originated through auto-intrusion caused by pressure on the crystal mesh of the crinanite. Similar syenitic bands occur in the crinanite of the smaller islands.

The age of the igneous activity is almost certainly Tertiary, and is probably the same as that of the Trotternish sills in Skye.

Although glacial striæ are not seen on the islands, their general aspect indicates a flow of ice from south to north during the Glacial Period.

THE ROYAL INSTITUTE OF PUBLIC HEALTH.

The Hon. Secretaries announce that the next Congress of the Royal Institute of Public Health will be held in the City of Portsmouth during Whitsuntide, 1930, from Wednesday, June 4, to Monday, June 9, on the invitation of the Lord Mayor and Municipality of that City.

The scientific work of the Congress will be conducted in the following Sections :—

Section I : " State Medicine and Municipal Hygiene."

Section II : " Naval, Military and Air (including Tropical Diseases)."

Section III : " Industrial Hygiene."

Section IV : " Women and Children and the Public Health."

Section V : " Tuberculosis."

The Meetings of the Congress will be held in the Guildhall and the Technical Institute, adjoining the Guildhall.

To this Congress delegates are being invited from the Governments, the Municipalities, the Universities, and other Public Bodies of Great Britain and Ireland, as well as from France, Italy, Germany, The United States of America, etc.

The Minister of Health will sanction the payment of the expenses of a delegate from each Local Authority in England and Wales whose accounts are subject to Government audit.

The Scottish Office and the Ministry of Home Affairs for Northern Ireland both agree to consider applications from Local Authorities to sanction the reasonable expenses of a delegate.

The Minister for Local Government and Public Health of the Irish Free State has intimated that he will be prepared to afford facilities to Local Authorities in the Irish Free State who may wish to send representatives.

Arrangements have been made with the railway companies for a reduction in the fares.

PHYSICAL SCIENCE TO-DAY.

Even if no great single advance has been made in the physical sciences during the last few months, many lines of investigation have been energetically pursued and in the present state the task of assimilation is unprecedentedly difficult. For new theories are not only difficult in themselves, but they imply a new conception of what is meant by a scientific explanation. They spring, as it were, from a different context; they result from a different attitude towards science itself. Their purpose is to provide mathematical specifications of phenomena. That also was the purpose of the older theories, but the older theories clothed the mathematical formulæ with physical bodies, as it were. When Maxwell found the electromagnetic equations, for example, he and his followers tried to show that these equations " meant " that space is filled with cogwheels, driving bands, gyroscopes, and what not. In doing this they were completely in sympathy with the plain man's conception of explanation. They pictured the ultimate processes of nature in terms of familiar images. The modern theories do not lend themselves to this kind of representation. They are mathematical theories which cannot be given a physical content.

NOTICES OF BOOKS.

Die Chemische Emissionsspektralanalyse. By PROF. WALTHER GERLACH AND DR. E. SCHWEITZER. Pp. vi + 120. Leipzig : Leopold Voss. 1930. Price 12 marks 80 pf.

This new and valuable work by Prof. Gerlach and Dr. Schweitzer appears at an opportune moment when scientists other than physicists are turning their attention to a study of Spectrum Analysis for help in elucidating various problems in other branches of science.

The authors have set out in a simple manner the fundamentals and the practical methods of procedure in conducting Emissiou Spectra Analysis. Its application in the detection and estimation of the amounts of various elements present in a substance under examination are dealt with rather fully. The necessary precautions and refinements in adjustment are emphasised and the possibilities and also the limitations of the method, especially as regards quantitative estimations, are discussed. The authors who have themselves made noteworthy contributions to this subject, have made a close study of the literature and they append a useful bibliography to the present volume which is worthy of the attention of physicists and physical chemists in particular.

Report of the Building Research Board. (Department of Scientific and Industrial Research), for 1928. Pp. viii + 142, with 40 illustrations. London : H. M. Stationery Office, Kingsway, W.C.2. 1929. Price 3s. 6d.

The third annual report of the Building Research Board provides a summary of the progress made during the calendar year 1928 in the section of the Department's activities devoted to Building and Constructional Science.

The prominent feature of the year's work is the greatly increased contact with the Industry. To achieve success in research connected with old established industrial processes, it is essential to secure full and sympathetic collaboration between the scientific worker and the man with the life-long practical experience. The gradual realisation of this aim is evidenced by the increase in the number of specia linnuiries dealt with during the period under review.

Following the precedent of the first two reports the document is again divided into "General and Special Researches" and "Intelligence and Special Investigations." The fundamental research in connection with the deterioration of building materials by weathering continues to make steady progress, and it is particularly true of this section of the work that the data accumulated are becoming sufficient to make possible the formulation of generalisations of wide significance. The account of the researches undertaken in connection with the repairs to the stonework of the Houses of Parliament is of importance, not only by reason of its intrinsic interest, but because it furnishes an example of the application of organised scientific research to a practical problem of national moment. Another important topic dealt with is the investigation of the stresses induced in reinforced concrete by small movements in the concrete due to a variety of causes.

The second portion of the report contains brief summaries of investigations undertaken at the request of the Government Departments and members of the building industry. These summaries should be of considerable value to those confronted with similar problems.

We have received from J. H. Sankey & Son, Canning Town, London, E., a folder and specimen of their new speciality, "Sankmar" plastic paint, available in a wide range of shades and textures. Readers may obtain further information on application to this firm.

Forthcoming Events.

THE OPTICAL SOCIETY.

Thursday, January 16, 1930, at 7.30 p.m. The following papers will be presented and discussed :—

"The Ross Modification of the Hilger Interferometers for Testing Large Optical Elements." By O. G. Hay, A.R.C.Sc., Member of the Technical Staff of Ross, Ltd.

"The Reflection Factor of Magnesium Oxide." By J. S. Preston, B.A., A.Inst.P., of the National Physical Laboratory.

Exhibits and Demonstrations—

"Scientype Occluding Glass for Use in the Treatment of Squint."

"A Visual Test with a New System of Equi-photic Illumination."

OIL AND COLOUR CHEMISTS' ASSOCIATION.

MANCHESTER SECTION.

The Fourth Meeting of the Session will be held at The Milton Hall, Deansgate, Manchester, on Friday January 10, 1930, at 7 p.m. The following paper will be read :—"Recent Research on Fats Bearing upon the Drying of Oils in Paint and Varnish." By Professor T. P. Hilditch.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Wednesday, January 15, at 8 p.m.—(Ordinary Meeting.) Joseph Burton, A.R.C.Sc.I., of Messrs. Pilkington's Tile and Pottery Co., Ltd. : "Quality in Pottery." Prof. H. E. Armstrong, Ph.D., LL.D., D.Sc., F.R.S., will preside.

Monday, January 20, at 8 p.m.—(Cantor Lecture.) Harold J. L. Wright ,of Messrs. P. and D. Colnaghi and Co. : "Three Master Etchers : Rembrandt, Meryon, Whistler." (Lecture I.)

EMPIRE MINING & METALLURGICAL CONGRESS (SOUTH AFRICA), 1930.

Among the papers for presentation at the Third Triennial Congress of Empire Mining and Metallurgy, to be held this spring (March 24 to May 9), in South Africa, are the following :—

Gold Metallurgy of Witwatersrand Banket Ores. By H. A. White.

Metallurgical Operations at Bwana M'Kubwa. By C. S. van der Poel.

The Coppepr-Nickel Industry of Ontario. By Thomas W. Gibson.

A Review of the Hygient Organisation of the Witwatersrand Gold Mines. By A. J. Orenstein.
Hydrogenation of South African Coal. By P. N. Lategan.
Gold Milling in Canada. By J. J. Denny.
The High-Lift Pumping Installations of the Randfontein Estate Gold Mining Company, Witwatersrand, Ltd. By W. G. C. Nixon.

Review of the Mining Industry of Canada:
Introductory Remarks. By Charles Camsell.
The Mining Industry in the Yukon and Northwest Territories. By W. E. Cockfield.
The Mining Industry of British Columbia. by J. D. Galloway.

The Mining Industry of Alberta:
(*a*) Coal Mining. By J. B. de Hart.
(*b*) The Oil and Gas Situation in the Prairie Provinces. By T. G. Madgwick.
(*c*) Notes on the Industrial Development of Alberta's Mineral Resources other than Coal, Oil, and Gas. By S. J. Cook.

The Mining Industry in Saskatchewan. By Thomas M. Molloy.
The Mineral Industry in Manitoba. By J. S. DeLury.
The Mining Industry of Ontario. By Thomas W. Gibson.
The Mining Industry of Quebec. By A. O. Dufresne.
The Mining Industry in Nova Scotia. By J. P. Messervey.
The Mining Industry in New Brunswick. By W. E. McMullen.
The Use of the Aeroplane in Mineral Development. By J. A. Wilson.
Present Day Practice of Diamond Mining, including Recovery. By Alpheus F. Willilams and John Harbottle.
The Alluvial Diamond Bearing Deposits of the Union of South Africa. By Alpheus F. Williams.

The Explosives Industry in South Africa with Special Reference to Rand Mining. By John Christie.
Use of Mechanically Operated Scrapers in Workings of Flat Dip, at the Modderfontein "B" Gold Mines, Limited. By C. L. Butlin.

Papers on Temperatures and Ventilation:
Ventilation at the Crown Mines. By A. J. Walton.
General Remarks on the Ventilation of the Mines on the Reef. By J. P. Rees.
Deep Level Mines. By E. C. Ranson.
Government Gold Mining Areas and Auxiliary Ventilation. By R. A. H. Flugge-de Smidt.

Papers on Shaft Sinking:
Sinking No. 16A Shaft at Crown Mines. By A. J. Walton.
The Sinking of Circular Shafts from Surface on the Witwatersrand with special reference to *Monolithic Lining and Double* Bucket Winding. By W. G. C. Nixon.
Notes on the Sinking of No. 4 Shaft, Springs Mines, Ltd. By J. C. Roxburgh.
Description of a Rectangular Sub-Vertical Shaft at the Robinson Deep Mine. By B. G. O. Orpen.
The Roan Antelope Mine. By D. C. Sharpstone.
Drill Steel and Drilling at the New Modderfontein Gold Mining Co., Ltd. By E. C. J. Meyer.
Notes on Jackhammer Drill Steel. By G. R. Heywood.
Tin Mining in South Africa with Particular Reference to the Metallurgical Practice at the Leeuwpoort Tin Mines, Ltd. By W. J. Gau and J. Irvine Jameson.
Short Description of the operations of the Organisations through which the Native Labour Employed by the Witwatersrand Gold Mines is obtained. By W. Gemmill.
Copper Concentration as Applied to Canadian Ores. By W. B. Maxwell.
Mining and Metallurgical Education in South Africa. By Professor G. H. Stanley and Professor G. A. Watermeyer.
Notes on Gas Power Plants as Used on Southern Rhodesia Mines. By B. W. Durham and W. Wallace.
The Chrysotile Asbestos Deposits of Shabani, S. Rhodesia. By F. E. Keep.
The Lydenburg Platinum Areas, Ltd., Maandagshoek Section. By W. T. Turvey.
Mining and Recovery of Platinum at Onverwacht Platinum, Ltd. By J. E. Healey.
Potgietersrust Platinums, Ltd., Notes on the Method Employed in Mining the Zwartfontein Central Ore Body. By K. Richardson.
The Development of the Mining Industry in Southern Rhodesia. By F. P. Mennell.

Papers on Cementation: ...
Underground Cementation. By J. C. Roxburgh.
Early Water Troubles and the Development of Cementation at the Geduld Proprietary Mines, Ltd. By E. P. Cowles.
The Cementation Process, with Particular Reference to its Application in Solving Problems met with in Mining. By G. A. Voskule.

First Aid Organisation in the Witwatersrand Gold Mines. By H. T. H. Butt.
Coal in Natal. By F. A. Steart.
Coal in the Transvaal. By J. McPhee.
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38,001.—Imperial Chemical Industries, Ltd.—Ammonia oxidation. December 11.

37,736.—Lonza Elektrizitatswerke und Chemische Fabriken Akt.-Ges.—Manufacture of double salts of calcium nitrate. December 9.

38,247.—Naamlooze Vennootschap de Bataafsche Petroleum Mattschappij. Manufacture of ammonium sulphate bisulphate. December 13.

Specifications Published.

296,309.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of N-oxyethyl-derivatives of 2-amino-1-oxybenzene.

306,447.—Geigy Soc. Anon., J. R.—Production of conversion products of azo-dyes.

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320,915.—Condensation products of methylol-ureas and thioureas.—Johnson, J. Y., 47, Lincoln's Inn Fields, London. (I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Water-soluble artificial resins are prepared by heating a methylol compound of urea and/or thiourea, or a crystalline etheric derivative thereof obtainable according to Specifications 266,752 and 296,361, or a polymer of dimethylol-urea or -thiourea prepared by splitting off water by means of alkaline agents, in at least an equimolecular quantity of a polyhydric alcohol or an ether thereof containing at least two free hydroxyl groups. Preferably an acid condensing agent is employed and the process is effected in the presence of a buffer substance capable of maintaining p_H between 4 and 7. The polyhydric alcohol or ether not only acts as a solvent, but also takes part in the reaction; sugars and other carbohydrates are excluded. The process may be operated in a continuous manner. Ac-

cording to the examples, (1) a suspension of *dimethylolurea in glycerol is heated with acid potassium oxalate or a mixture of* primary and secondary sodium phosphate until dissolution occurs after neutralisation and filtration, a viscous product is obtained which can be used as a plasticizer for gelatine; a similar product is prepared by heating monomethylolurea, suspended in glycerol, with oxalic acid and neutralising with tertiary sodium phosphate; (2) dimethylolurea is heated with diethyleneglycol ether and tartaric acid and gives a product which, after neutralisation and filtration, can be *employed as a plasticizer for casein.* Specifications 261,029 and 301,696 also are referred to.

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POTASSIUM: ITS RADIOACTIVITY: ITS ISOTOPES: AND ITS ASSOCIATION WITH THE PHENOMENA OF LIFE.

By F. H. Loring and J. G. F. Druce.

Introduction.

In 1907 N. R. Campbell[1] discovered that potassium and rubidium spontaneously emitted β-rays. The determination of this activity, which is very feeble, is difficult, but a recent counter method of H. Geiger and W. Müller may be helpful here.[2] There appears to be no end-product of change in these two cases.

It was therefore suggested by one of us[3] that this radioactivity might be of a type in which electrons were absorbed into the atom structure almost as frequently as they were given out, thus representing a sort of balanced radioactivity — intermediate between normal radioactivity and no radioactivity at all.

It was further suggested by one of us[4] that possibly this feeble radioactivity in so common an element as potassium was the starting basis of all life. It is well known that living or growing matter possesses a certain amount of potassium, though perhaps in some very low orders of life the amount need only be small.

Roscoe and Schorlemmer[5] had remarked that potassium is taken up by rootlets, as "no vegetable growth can flourish without it." Furthermore, that plants cannot "absorb rubidium salts in place of potassium salts, and they die if the latter salt is not present (Luscanus) . . . It is a remarkable fact that plants do not take up any cæsium compounds from the soil, and in the absence of potassium compounds, cæsium acts as a poison upon vegetable life (Luscanus)."

Passing to a recent research, attention may be drawn to the observation that heart-beat is started by radioactive potassium, according to the work of H. Zwaardemaker[6] at the University of Utrecht. The experiments seem to indicate that a suitable element that is radioactive is necessary to diet.

By a process of elimination it is possible to arrive at those elements fundamentally essential to life. A given element for example is very important in many cases, but if a low order of life can be found without the presence of this element in the life substance, then it is thus eliminated as an essential basic feature in life. It might then be possible in this way to find a case where potassium was absent. The possibility of some contamination of a radioactive element apart from potassium would have to be considered; but there is another feature in connection with potassium that D. T. MacDougal (director of the Carnegie Institution of Washington's Laboratories for Plant Physiology at Tuscon, Arizona, and Carmel, California) has worked out.[7] This investigator made a paper thimble one inch in diameter by three inches long. This was coated on the outside with a mixture of agar-agar and pectin (prepared by boiling these substances together) and treated with alcohol to remove some of the water present. The inside of the tube was coated to a thickness of one-quarter inch with a hot mixture of gelatine and agar-agar to which some fat, a little soap and a minute quantity of salt had been added. This coating substance was supposed to simulate the plant protoplasm. After hardening, the open end of the thimble or tube (cell) was closed with a stopper provided with two glass tubes—one for filling and the other for an overflow.

A solution of sugar was poured into the cell, thus providing the sap as in a real cell. This artificial cell demonstrates an activity that can be described thus (the numbers are merely introduced to accentuate the features though interconnected):—

Activity 1.—If the cell is placed in a beaker of water, pure water or water with some salt dissolved in it, the water alone, or the water with salt, will pass through the cell-wall into the sugar solution.

Activity 2.—If the cell was originally full of sugar solution the presence of the outside solution would cause the cell to overflow, the amount of overflow being said to represent the activity of the cell.

Activity 3.—If certain pairs of salts are dissolved in the water in the beaker, a curious action takes place. For example, sodium and potassium which are chemical analogues behave quite differently, for 60 times as much potassium is absorbed as sodium, but these figures are those in actual life cells or processes, yet the above cell imitates this selective property in the ratio of 5 to 1 instead of 60 to 1.

Physical chemistry is involved here and one would expect Activities 1 and 2 to take place, as the phenomenon is evidently osmotic.

From the above it may be gathered that the study of the peculiarities of the chemical elements may be helpful in gaining some insight into the fundamental activities which give rise to the complex processes of life. Many elements are present in plants and the number of more or less essential elements, apart from the structural elements

such as carbon, oxygen and hydrogen, has been extended by the work of J. S. McHargue and of others.

Potassium, however, stands out as exceptional.

Now this element has two isotopes of masses 39 and 41 (of about the proportion $3 \cdot 39$ to $1^{5} \times 41$), as first shown tentatively by one of us,[8] which was afterwards confirmed experimentally by F. W. Aston.[9]

EXPERIMENTAL.

If, as seems probable, *one* of the potassium isotopes is active (or more active than its associate) in emitting β-rays, it might be that by some such process as MacDougal has experimentally demonstrated, there would be a selective absorption by the plant, and if this is the case the ash from the plant might be a little more radioactive in consequence, and by atomic weight determination any quantitative increase of one isotope due to the above action might be detectable.

Accordingly it was decided to investigate this matter experimentally. A trial plot of potatoes comprising about 200 plants was manured by sprinkling the soil with 25 pounds of potassium chloride before "moulding up." The soil was loamy and had been subjected to the usual treatment of manuring with stable dung. The season (1929) was very dry, and it is reasonable to suppose that the potato plants had a good opportunity of utilising the artificial fertiliser (KCl) which was not washed away too early by rain.

After the crop (an average one) was lifted the haulms were collected and burnt, leaving nearly 20 pounds of ashes. The ash was treated with the minimum of water (3,500 cc.) with which it was convenient to extract most of the soluble potassium salts. No attempt was made to extract the whole of the soluble matter, as it seemed desirable to remove only the more readily soluble salts, so that potassium carbonate would be less contaminated with any other metals likely to be present.

The very alkaline filtrate so obtained, after being made just acid with 4 normal hydrochloric acid and allowed to stand, was filtered again, leaving behind a small crystalline deposit.

The filtrate was then treated with hydrochloric acid gas which gave a copious crystalline deposit of crude potassium chloride amounting to 180 grams, whilst a good deal of soluble matter still remained in the filtrate. The precipitate was re-crystallised from hot water after rejecting the first fraction.

The main crop was again dissolved in cold water and re-crystallised with hydrochloric acid gas and the precipitate was further re-crystallised from hot water, drained and dried and finally heated for several hours in an air-oven kept at 105° C. About 8.5 grams of material were obtained.

One gram was dissolved in 20 cc. of water for testing purposes. Half this solution was tested with a few drops of reagent, barium chloride solution, to ascertain whether there was present any sulphate. A faint, but distinct, opalescence developed, but the amount of barium sulphate formed from 1.5 gram of KCl could not be weighed to 0.1 mgr. The presence of the nitrate, bromide and iodide, could not be detected, nor was calcium, magnesium or any heavy metal found to be present by test. Examined spectroscopically it was found that sodium (probably only a trace) was present, but no lines of rubidium or cæsium could be seen.

Analysis of the Potassium Chloride.

A standard solution of 2.2190 grams of KCl in 200 cc. of water was made.

Aliquot portions were titrated with a carefully made silver nitrate solution.

20 cc. of the potassium chloride solution required 29.2 cc. of N/10 $AgNO_3$ to precipitate the chloride. Therefore 35.46 grams of Cl combine with 40.53 grams of K.

10 cc. of the potassium chloride solution required 73.0 cc. of an exactly N/50 $AgNO_3$ solution, so that from this titration it is found that 35.46 grams of Cl are combined with 40.53 grams of K.

In a gravimetric determination of the chlorine in the "biological" KCl it was found that 0.1049 gram of KCl gave 0.1982 gram of AgCl, so that 35.46 grams of Cl are combined with 40.40 grams of K.

In another experiment, a small measured quantity of the potassium chloride gave on heating with sulphuric acid 0.7642 gram of K_2SO_4, and this on solution in water and precipitation with barium chloride gave 1.0064 grams of $BaSO_4$. Assuming Ba = 137.37, S = 32.064, the equivalent for potassium is 40.59.

Thus it will be seen that potassium comes out high in each case, averaging in atomic weight 40.5. The standard value is of course 39.096.

It would appear therefore that the isotope of mass 41 was in greater evidence as due to a biological enrichment. So far as known this is the first evidence that the isotopes of

an element can be partly separated by biological means; and, being no doubt important, this phenomenon requires further investigation.

Radioactivity of the Chloride.

The potassium chloride prepared from the ashes as above was found to be more radioactive than the ordinary salt of mineral origin. In the course of seven days it affected sensitive photographic paper which on development showed a distinct dark patch where the salt (wrapped in black paper) had been placed, while the ordinary salt produced on the same piece of paper a scarcely perceptible darkening, the time of exposure being of course the same.

COMMENT.

It is realised that contamination from soil radioactivity or radioactive matter carried in the atmosphere is a contingency to be carefully weighed; or investigated in connection with this line of work.

If, however, there is a biological isotopic enrichment, as appears to be the case, then repeated treatments of plants by the enriched residue obtained each time would possible give a graded increase. This might be described as a plant fractionating process that would take some years to demonstrate to an extent sufficient to show enhanced effects.

In referring to biological work it will be understood that we have not made an exhaustive study of the researches in this field bearing upon the particular work hereinabove cited.

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2. H. Geiger and W. Müller, *Phys. Zeit.*, 1929, *30*, 489-498; see also H. Newfeldt, *ibid.*, 494-495.
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A NEW CONCEPTION OF RELATI CONFIGURATION.

By CHARLES EDMUND WOOD AND

SYDNEY DIGGARY NICHOLAS.

(*University of Birmingham.*)

(*Continued from page 6.*)

DISCUSSION OF THE THREE DIFFERENT METHODS.

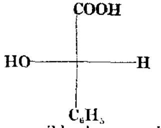
From an historical aspect the two ess tially different methods (generic and e pirical) of defining relative configuration of interest.

Frankland (*Trans. Chem. Soc.*, 1913, c 738) in his presidential address to the Che cal Society in 1913 on the Walden Invers stated that " there does not exist at present time any criterion whereby the re tion between the configuration of an opt ally active compound and that of a deri tive from it can be decisively ascertained He emphasised the fact that recourse had be made to hypothesis and cumulative e ence such as rotational displacements deducing configuration for in the gene changes there was a possibility of a Wald Inversion.

In 1918 Clough (*Trans. Chem. Soc.*, 19 CXIII, 526) developed the use of such co firmatory evidence and founded a ru whereby configuration could be deduc without reference to generic changes. took as standards of comparison lact glyceric, malic and tartaric acids a assumed that the optical rotatory powers similarly constituted compounds possessi the same configuration are in general fluenced similarly by the same changes the external conditions (temperature, s vents, saline solutions, etc.), and also by t introduction of the same substituent into given radicle attached to the asymmet carbon atom (ester to amide, methyl ethyl ester, etc.).

By his rule he assigned configurations widely differing compounds as tyrosi α-hydroxy-β-phenyl-propionic acid, phen chlor-acetic acid, etc., and the assumpti has been made that configuration as defin by the arrangement of the -H, -Ol -COOH groups is always the same as co figuration defined by rotational displac ments.

For the majority of the α-hydroxy-aci this is no doubt the case. But it is possib (the reason will be seen after the alcoho have been discussed) that mandelic ac denoted " d " from cumulative eviden might possess the space formula

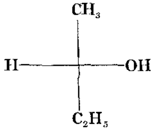


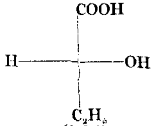
f proof were possible by generic changes i.e., correspondence of the three groups by processes of synthesis and degradation). If his is the case, configuration determinations by cumulative evidence such as rotaional displacements fail. Likewise, there eing no longer cumulative support as demanded by Frankland to ensure against Valden Inversions the generic method also ails.

Owing to the empirical nature of the non-generic methods it was not suspected that the above two modes of defining configuration could lead to contradictory results.

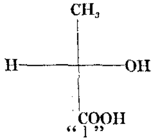
Empirical methods, applicable to the acids break down when applied to other series, for instance the alcohols, etc—the exceptions being too numerous to formulate any rules based on the rotational displacements of the *α-hydroxy-acids*.

The generic method (correspondence of three groups) has also of necessity no meaning when applied to the alcohols. Methyl ethyl carbinol is a compound of relative configuration " d " on comparison with " d "-α-hydroxy-butyric acid but of relative configuration " l " on comparison with " l "-lactic acid.





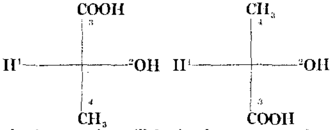
" d "



" l "

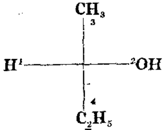
The criterion of anomaly, however, can be applied to any series. Accordingly a general definition of configuration can be made and, o the restricted and different generic definiion, only geneological (not entiomorphic) significance must be attached. In reality, he generic definition had been displaced wherever configuration was assigned to a compound of unknown generic formulation; or the assumption underlying the empiric method had not been realised.

All compounds whatever series they belong to showing anomaly in the positive region are *of " d " configuration and vice versa*. The configuration of a componnd is regarded as " d " or " l " when the electron frequencies of the four pairs of coupling electrons are in the order of magnitude corresponding to a " d " or " l " α-hydroxy acid, the sign of the high frequency term in the Drude equation being taken as a criterion of the order. In " d " and " l " lactic acids

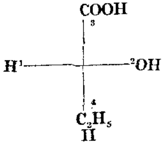


the frequencies will be in the reverse order, and, on the assumption that the frequencies corresponding to the linkages decrease in the order

$$C\text{-}H > C\text{-}OH > C\text{-}COOH > C\text{-}CH_3 > C\text{-}C_2H_5$$



I



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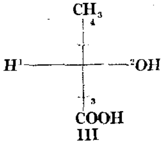
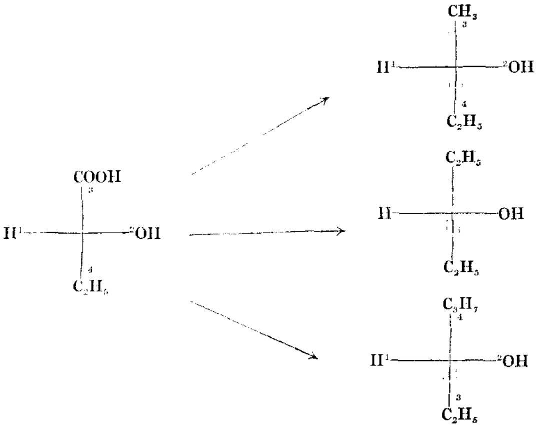


III

I will have the same order as II but the reverse of III. Accordingly the configuration of I is " d." The reason why the generic and the anomaly methods of determining configuration in the α-hydroxy acids, *as far as is known, agree is because the electron frequencies of the linkages* C-H, C-OH, C-COOH are very likely far *removed from the normal and so the order of* the frequencies is not altered by substitution

of a group such as higher alkyl, $-CH_2COOH$, etc., for the $-CH_3$ group in lactic acid. The phenyl and cyclo-hexyl groupings, probably, do not change the order of frequencies

i.e., C-H>C-OH>C-COOH>C-most other groups. The case is quite different when the outstanding frequency group $-COOH$ is replaced by R (an alkyl radicle, phenyl group, etc.). Consider the passage of "d" α-hydroxy butyric acid to methyl ethyl carbinol and ethyl propyl carbinol.



The order is the same

Case I.

Inactive.

The order is reversed.

Case II.

Case I.

$C-H>C-OH>C-CH_3>C-C_2H_5$

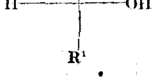
First member of the methyl series of carbinols. It is dextro-rotatory. Configuration is "d" from considerations of the region of anomaly. Space formula is based on the work of Levene and Haller (*J. Biol Chem.*, 1927, LXXI, 465).*

CASE II.

$C-H>C-OH>C-C_2H_5>C-C_3H_7$

Ethyl-propyl carbinol is the "l"-entiomorph of the first member of the ethyl series. It is levo-rotatory and from considerations of anomaly "l" configuration. Space formula is based on the work of Levene and Haller (*J. Biol. Chem.*, 1927, LXXIV, 344).*

In general $C-H>C-OH>C-R \gtrless C-R^1$

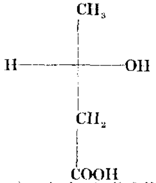


When $R>R^1$ configuration is "d."
When $R<R^1$ configuration is "l."
When $R=R^1$ inactive.

The preceding discussion has shown that the generic definition of configuration is restricted to compounds the geneology of which can be traced by a chain of chemical transformations. In the α-hydroxy acids very few transformations have been effected and the definition is practically restricted to tartaric, malic, glyceric and lactic acids. Its real justification is in its application to the carbohydrates to which it was originally applied, for in these compounds the reference groups $-H$, $-OH$, $-COOH$ (or $-COOH$ modified to $-CH_2OH$, $-CHO$, etc.) still persist and further the nature of such groups allow of generic changes. Frankland's note

* Certain rotation data might appear to indicate reversed formulæ but as no grouping attached to the asymmetric carbon atom has been directly replaced in the transformations involved in Levene and Haller's work, no Walden inversion can be reasonably assumed.

concerning Walden inversions however must be borne in mind. For other classes of compounds even apart from the impossibility of tracing in most cases generic changes the *definition has no meaning, e.g.,* when applied to



the configuration is both " d " and " l " at one and the same time.

The restricted non-generic empirical methods can be replaced by the general anomaly method which is applicable to all series. This passage from a particular to a general definition arises from (*a*) the establishment of the anomaly criterion in place of the empiric methods, (*b*) the fact that two different conceptions have, unknowingly, been in use, the generic and the non-generic (enantio-morphic). The unrestricted conception is naturally the one chosen as defining configuration.

Both conceptions (generic and non-generic) are stereometrical but in different ways. The generic conception ignores the physicists' demand for an irregular tetrahedron (Lindmann, *Ann. Physik.*, 1924, LXXIV, 541, etc.; Thomson, *Phil. Mag.*, 1920, XL, 713) for it is concerned not with molecular shape but merely with the space order of the groups -H, -OH, -COOH arranged at the corners of a regular tetrahedron and so gives a purely geneological and not necessarily an entiomorphic relationship.

The conception based on anomaly postulates an irregular tetrahedron (this idea of an irregular tetrahedron can be traced back through Van't Hoff and Le Bel to Pasteur's original conception of " molecular dissymmetry" (cf. also Jaeger's lectures on the principle of symmetry, p. 228)) and depends, not on the mere space order of a set of particular groups, but on a right-handed and left-handed non-super-pose-ability of shape (not groups) accompanied by the right and left-handed order of frequencies. Accordingly, all compounds are placed in two classes the " d " enantio-morphs and the " l " enantio-morphs. This the empiric method attempted to do to a limited degree and in this connection the two empiric methods which involve dispersion should be mentioned.

Freudenberg (Freudenberg and Rhino, *Ber.*, 1924, LVII, (2), 1547) deduces relative configuration by comparison of dispersion curves which are approximately simple or have been extrapolated to simplicity.

Clough (*Trans. Chem. Soc.*, 1926, p. 1674) employed Patterson's rational zero of rotation (*ibid.*, 1916, CIX, (2), 1176) for comparing dispersion ratios. This method also modifies data to avoid anomalies, yet in view of the significance of anomaly, use can be made to a certain extent of Patterson's rational zero as a guide to the region of anomaly.

Though the method based on anomaly indicates the shape, *i.e.*, the enantio-morph, yet the space formula must be determined. If the individual frequencies relative to one another were known the space formula could be written down. Independent of the physicist, knowledge of the frequencies can be gained from the consideration of : (*a*) the alcohols, (*b*) α-, β-, etc. hydroxy acids, (*c*) the Walden Inversion.

Theory of Anomalous Rotatory Dispersion.

The omission to co-ordinate configuration and anomaly has led to theories being put forward both from the chemical and the physical sides, which are inadequate.

The chemical view is that anomalous rotatory dispersion is due to the presence of two or more iso-dynamic forms of an optically active compound. This view can be traced back to Arndtsen's (*Ann. Chim. Phys.*, 1858, (3), LIV, 415) explanation of the dispersion of solutions of tartaric acid.

Armstrong in 1881 (article on " Light " 3rd supplement Watt's *Dictionary of Chemistry*, p. 1208) stated " the most probable explanation of the anomalous rotatory dispersive power of solutions of tartaric acid would appear to be that they contain, besides the acid, a compound of opposite rotatory power of the acid with water, in proportions varying according to the concentration and temperature of the solutions ", and in 1913 with Walker (*Proc. Roy. Soc.*, 1913, *A*, LXXXVIII, 388), formulated characteristic diagrams in terms of this theory.

The theory has been developed and extended by Lowry since 1914 (*Trans. Far. Soc.*, 1914, X, 57). Its weakness lies in the ever increasing cases of anomaly without isoation of isomers. Even from tartaric acid, on which the theory was based 70 years ago, no isomers have been isolated.

A theory which attempts to explain anomaly without recourse to isomers is that of "induced asymmetry in unsaturated molecules" (Lowry and Cutter, *Trans. Chem. Soc.*, 1925, 127, 607). This theory also has no configurative meaning.

The failure to establish a satisfactory interpretation arises from the neglect of Drude's theoretical deductions and only an empirical application being made of his equation.

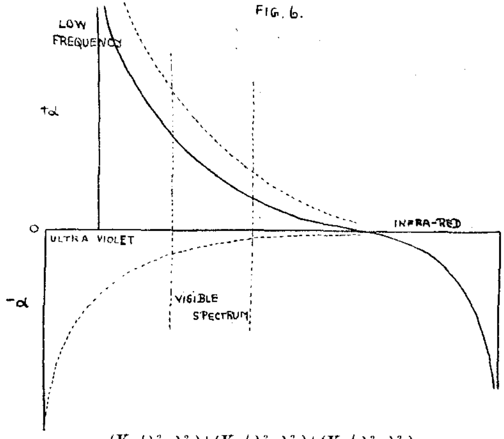
Dispersion for all optically active compounds is represented by a one or two term† Drude equation, the frequency or frequencies being confined to *the ultra-violet. It is* assumed that the infra red frequencies are absent (Lowry, *Trans. Chem. Soc.*, 1915, CVII, 1197). No definite proof has been given to support the assumption, but a strong case against such an assumption is the fact that the dispersion of quartz requires the infra red term. This was shown by Lowry who re-determined the rotations of quartz to a great degree of accuracy. Drude himself had concluded "that the *kinds of ions whose natural periods lie in* the ultra red are inactive." The data available at that time did not justify the inclusion of an infra red term.

Organic compounds give, compared with quartz, relatively small rotations and so extreme refinement in measurement and research in the infra red may be necessary to prove that part of the dispersion is contributed by an infra red term or terms. On the other hand all that may be necessary is *adjustment of constants; the significance of* the infra red term having been overlooked. There is no justification for placing quartz *in a class by itself. The present procedure* of representing dispersion only by ultra violet terms is but half the explanation.

The case of left-handed quartz is represented diagramatically below.

† α'β dibromo camphor is exceptional, the dispersion is of greater complexity than can be represented by a two term Drude Equation. (Cutter, Burgess and Lowry, *Trans. Chem. Soc.*, 1925, CXXVII, 1260).

FIG. 6.

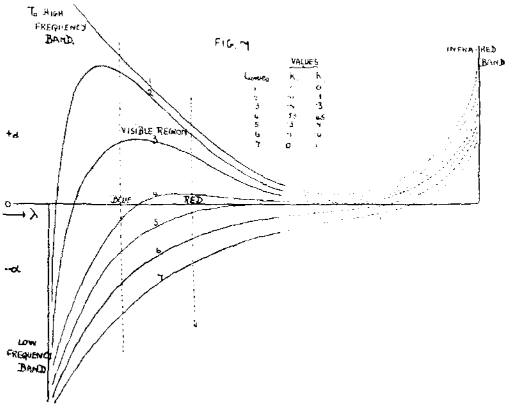


$$\alpha = -(K_0/\lambda^2-\lambda^2_0)+(K_1/\lambda^2-\lambda^2_1)+(K_2/\lambda^2-\lambda^2_2)$$

High Frequency Low Frequency Infra Red

The high frequency constant λ_0 is small in the case of quartz and may be omitted, it is associated with a negative rotational constant. *Left handed quartz is therefore of* "l" configuration. Reversing the signs of the terms of the equation gives the case for the rotatory dispersion of right handed quartz, *i.e., the enantiomorph.* The general

equations so obtained are considered to represent the cases of all organic compounds exhibiting anomaly. Thus the curves in Fig. 7 on proceeding into the infra red neither run asymptotic to the zero axis nor die away in the infra red but are directed to a band. Thus rotatory dispersion takes place between bands.



Modification of the Drude equation is necessary when expressing dispersion near to a band. The substance becomes coloured and exhibits circular dichroism.

Since the quantum and undulatory theories are opposed and mutual interrelationships not understood, the classical theory is followed. The dispersion expressed by the ultra-violet terms is considered to be of electronic origin while that expressed by the infra red term is of atomic and molecular origin.

Examination of the above curves shows that their path in the visible region is controlled by the infra red term, that is, the visible dispersion through electronic is of atomic and molecular origin and so results the restriction of anomaly to a particular region.

The failure of the isomer theory lies in the fact that it does not assign the effect to a single moecule. Though the cause is regarded as due to molecules yet the explanation offered is based on a purely electronic interpretation.

Certain exponents consider that each ultra violet term corresponds to a molecular isomer.

(To be continued.)

LIEBIG'S EXTRACT OF MEAT COMPANY, LTD.

Extract from Sixty-Fourth Annual Report.

Profit for the year to 31 August, 1929, £371,125 14s. 11d.; brought forward from last year, £255,823 8s. 5d., making a total of £629,949 3s. 4d., out of which the following dividends have been paid or provided: One year's dividend on 200,000 Preference shares of £5 each—£50,000; Interim dividend on 400,000 Ordinary shares of £5 each —£140,000; total £190,000; leaving available £436,949 3s. 4d., which the Directors propose to deal with as follows:— To pay a Final Dividend of 9s. per share, free of income tax (making with the Interim Dividend 16s. per share, free of income tax, for the year)—£180,000, leaving to carry forward to Profit and Loss New Account £256,949 3s. 4d.

IMPORTANCE OF CHEMICAL RESEARCH.

WHAT IT HAS DONE AND WILL DO FOR CANADA.

PROBLEMS TO BE TACKLED THERE ON BOTH BUSINESS AND SCIENTIFIC LINES.

FROM A CANADIAN CORRESPONDENT.

Had Great Britain a superiority in technical knowledge the war could have been finished a year and a half earlier, is the opinion of Dr. H. M. Tory, head of the National Research Council of Canada. The latter country is therefore determined to make no such mistake in the future — not because of possible wars but because the business interests of the Dominion demand the best possible equipment for the advancement of the industrial welfare of the country. With that in view the Canadian Government has opened its purse with a preliminary gift of £600,000 for the erection of a Research Building at Ottawa, with all the other money required from time to time to make Science the handmaiden of modern Canadian industry. To begin with the new Research Building will be the best of its kind in the world, while is it intended to make the laboratories therein the equal of any and the superior of most.

Taking its lesson from the Great War, Canada started research work in 1921, the Government increasing the grant yearly as it realised the importance of the results. Only scientists, however, know the possibilities in research. As Dr. Tory pointed out in a recent reference to the subject, if 100 molecules were taken, the number of formulæ that could be written down on what those molecules could do would fill all the pages of all the books in all the libraries in the world.

In Canada the chemical industries alone now represent a total investment of £175,000,000. The new laboratories—the building for which will be completed in 1930—are expected to considerably improve the position of some, if not all, of these industries.

HOW TO GET A "PLACE IN THE SUN."

Speaking of the value of research workers, Dr. Tory pointed out there has first to be inculcated in the minds of science students, and in universities, the need for developing the research student, and scholarships have brought this type of man along. At Ottawa two distinct lines of research will be followed. The first has to do with public research, by the public and for the public, and the information, when found, is made public. There are five or six large divisions of that work that were got under way on December 1 in provisional quarters. Then *there is the other type of research, carried* on in a similar way to that done by the Mellon Institute in the United States. If a certain institution wants work done on a certain line of investigation, it co-operates with the Research Council and aids the research financially. The benefit of that work accrues to the company, the Government meanwhile having put its plant and its brains at the disposal of the research.

Dr. Tory's idea is that this new enterprise at Ottawa will put Canada in the sun, industrially, more than any other efforts which could be put forth, at least by the Government of the Dominion. In former days a place in the sun implied to most people something to be achieved by sabre-rattling and display of military forces. But nowadays public ideas have changed, and a national place in the sun is felt to depend on strong, well-organised business and commercial developments; national character; a well-balanced political situation; well-chosen laws, and a population ready to obey them.

Dr. Tory believes that if too many Canadian businesses were controlled by foreign interests, there would be a grave danger to Canadian nationalism. It was important that all research work for Canadian industry should be done by Canadian and British institutions, otherwise the bright young brains of Canada which are capable of doing research work will inevitably go abroad to countries where such work is being done, and Canada might drop to a position of intellectual inferiority.

ILLUSTRATING THE POSSIBILITIES.

In the same connection Dr. Harold Hibbert, professor of Cellulose and Industrial Chemistry at McGill University, Montreal, declares that industry in all countries needs the benefits of research more than ever. The present age being a dynamic one, with methods of production changing from day to day, the need grows greater every year. In respect of agriculture there are great possibilities for co-operation between the chemist and the farmer, or groups of farmers. Much has been done, but there is more to be accomplished, for instance, in the development of new varieties of wheat. The utilisation of farm waste opens out almost unlimited opportunities. Corn-stalks and similar cellulose-producing plant waste matter has already been the source of important basic materials for the manufacture

of paper pulp, building materials, gas and other valuable products, even foodstuffs.

Dr. Hibbert states in this connection that Canadian agricultural colleges must get busy and contribute more to the solution of farm problems, a statement which of course has its application to Great Britain as well. The chemist has an important part to play in the improvement of agricultural methods. Recent experiments show that when the eyes of potatoes used for seed are dipped in a certain chemical, the plant flowers and produces potatoes in a much shorter period. In the same way it may be possible to bring fruits to maturity much earlier, getting an apple crop in July instead of in early autumn.

Canadian textile interests are watching carefully the development of plants which may serve as substitutes for the cotton plant, with the very great advantage of being grown in Canada. There is also the hybrid plant, brotex, evolved in England, and which is expected to make Great Britain independent of cotton growing countries for raw materials in the great Lancashire cotton industry. Growing of soya beans for the production of valuable oils used in the making of oleo-margarine present possibilities for Canada, too, as well as for England.

Other Features of Research.

Professor Hibbert, like Dr. Tory, is an enthusiast on the subject of Canadian research with relation to all the great natural industries of the Dominion. Mining, for instance, can be given an impetus through the co-operation of research bodies with that industry. Already the manufacture of fertilisers has been turned upside down through the production of synthetic ammonia. Fertilisers can be made without the use of imported potash or Chili saltpetre at the fertiliser works being developed at Trail, British Columbia. Waste gases from steel plants will be used to make basic materials for this industry.

The timber business is one of the most unsatisfactorily developed. Approximately 65 per cent. of the trees cut for timber now go into waste products. Much of this waste could be made into building boards through a chemical process. Canada cannot always expect to have such large available supplies of pulp wood. The research worker will now be employed to devise new methods of conservation, utilisation of waste products, and to develop a more rapidly maturing tree to be used for making wood pulp.

The manufacture of textiles from wood pulp offers a great field of increasing development for the Dominion. Undoubtedly, the production of textiles from wood pulp will increase, as wood is a cheaper raw product than cotton. Canadians will no doubt co-operate to make this essentially a Canadian industry, since they have the best available supplies of sulphite pulp.

The petroleum industry is also the objective of some of Canada's cleverest research workers. There is to-day a tremendous wastage of natural gas in Alberta, where huge burning jets serve only to light up surrounding areas. Canada has also the raw materials necessary for a number of other chemical industries.

NATURAL SCIENCE IN INDIA.

A meeting of scientists from the universities and other institutions of the United Provinces, held a conference recently at Allahabad, to formulate a scheme for an Academy of Sciences. The meeting discussed the possibility of starting an all-India Academy, but it was agreed that a beginning should be made with a provincial organisation, leaving the initiative for starting the all-India body to the Science Congress.

Sir Malcolm Hailey, the Governor, in opening the annual session of the Indian Science Congress, held at Allahabad, under the presidency of Colonel Christophers, Director of the Medical Research Institute, Kasauli, strongly advised the co-ordination of scientific research by such a body as an Academy of Sciences. He asked whether some more conscious co-ordination among research workers in the universities was not possible as an aid to those who were engaged in attempting the solution of practical problems affecting every-day needs. He was well aware that there were definite limits to the extent to which the efforts of research workers or students could be directed to these problems and that the co-ordination of their labours could not be directed from outside. It must be voluntary effort, or, at most, must be advice to some academy of science which would contain authoritative representatives of all the specialised branches of scientific activity working in the Provinces. But if some form of visible co-ordination could be attempted, and it could be proved to the public that science workers were contributing at least some of their energies in the direction suggested, they would have a far more effective case in calling for that public support upon which further progress must depend.

GENERAL NOTES.

THOSE BACK NUMBERS.

Regular readers of *The Chemical News* will have observed from the advertising columns that quite a number of issues of this Journal are "out of print," and are being sought by scientists anxious to complete and bind their sets.

It occurred to the writer to look through copies of these scarce numbers in order to ascertain the cause of the unusual demand for these particular issues. It will be recalled that the first issue of *The Chemical News* appeared in 1859, and it is natural that by this time, seventy-one years later, the early numbers have been exhausted. Again the restrictions and difficulties of production during the Great War has necessarily led to the stocks of these years rapidly becoming exhausted.

Neither of these reasons can, however, be applied to the scarcity of later issues and it may be inferred that they mnst have contained some contribution of special importance and which has since attracted attention.

Many of the numbers in the first volume of 1919 are "wanted" and it is significant that they include among their contents articles covering more particularly, select fields in organic and physical chemistry in which there was keen interest at the time. The issue No. 3213 (Feb. 20, 1920) contains an important contribution on a rapid method for estimating carbon monoxide in air — a subject well to the fore even to-day. It has, indeed, become more urgent than ever.

That the number 3400 (May 8, 1925) is scarce may be due to the fact that it contains an appreciation of Prof. B. Brauner's jubilee and would, therefore, have a special interest to this distinguished scientist's wide circle of friends in England and abroad. The same number contains also one of Mr. R. F. Hunter's articles on substituted benzothiazoles; a note on selenium, and there are finally several announcements of more than usual interest in the Proceedings of Societies.

The first issue for 1928 (No. 3534, Vol. cxxxvi, Jan. 6) is noteworthy since it includes an account of Stellar Energy and Cognate Phenomena, by Mr. F. H. Loring, and also one of the last contributions from Prof. E. Fahs Smith, entitled "A Glance at the Early History of Organic Chemistry in America."

PATENTS IN 1929.

Still Higher Figures.

Although the year 1928 showed the highest figures in Patents applied for at H.M. Patent Office in any one year, *viz.*, 38,593, Messrs. Rayner & Co., the well-known London Patent Agents, inform us that the total for 1929 is 39,927.

This total is especially satisfactory remembering the severe financial depression in the latter part of last year.

The extraordinary activity, however, shown by the Patent Office for 1929 clearly points to the onward trend of progress and enterprise in the world of inventions, the corresponding total for 1913, the last prewar year, being only 30,102.

There does not appear to have been any startling or even outstanding new inventions last year, but more improvements and developments have been brought forward to improve the character and cheapen the production of our manufactures, which conduce so much to the benefits ond comforts of all classes.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

Board of Trade Announcement.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during December, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 690, of which 562 were from merchants or importers. To these should be added 4 cases outstanding on the 30 November, making a total for the month of 694. There were dealt with as follows :—

Granted—650 (of which 621 were dealt with within 7 days of receipt).

Referred to British Makers of similar products—38 (of which 35 were dealt with within 7 days of receipt).

Outstanding on 31 December—6.

Of the total of 694 applications received, 656, or 95 per cent., were dealt with within 7 days of receipt.

Imperial Chemical Industries announce in answer to suggestions that the industry is depressed, that their world trade was greater in 1929 than ever and there is no reason to suppose the expansion will not continue.

Proceedings and Notices of Societies

SOCIETY OF GLASS TECHNOLOGY.

December 18, 1929.

Papers read :—

The Choice of Annealing Schedule for Commercial Glassware. By J. B. Murgatroyd, B.A. (A communication from the Laboratory of the British Hartford-Fairmont Syndicate, Ltd., Greenford.)

The two principal conditions governing the type of schedule to be chosen were (a) the composition of the glass, and (b) the amount of strain permissible in it, after being annealed. The composition of the glass controlled the annealing temperature and the annealing range. For the purpose of the investigation these terms were defined as follows. For annealing temperature, the definition of F. Twyman was accepted, namely that temperature at which at least 95 per cent. of the strain in glass was relieved in 3 minutes, the determination being made by the bending bar method. Annealing range was that range of temperature below the annealing temperature extending to the point where only 1 per cent. of existing strain was removed in 3 minutes. A safe figure for the annealing range was 50°. In actual works practice larger ranges must be allowed in lehrs, even as much as 100°. The author then discussed the kind of temperature gradients allowable in cooling through the range. These were two possible conditions :— (I) where the annealing temperature (as defined) was higher than the critical point where the expansion coefficient increased, and (II) where the annealing temperature was at or below this critical point.

It was not possible to state definitely the relative positions of the annealing temperature and critical temperature for expansion, but of several glasses examined it was found that the annealing temperature was 40° to 50° higher than the critical temperature. The problem was discussed mathematically and certain results obtained. For ordinary soda-lime-silica glassware, of an average thickness of 0.5 cm., the annealing schedule might be as follows :—

15 minutes for the ware to become uniform and strain free at the annealing temperature.

10 minutes for the annealing range of 50° at 5° per minute.

There would then remain a range of about 450° over which an average rate of cooling of 10° to 15° could be maintained in most lehrs, requiring, say, 35 minutes. The most economical schedule for ordinary glassware therefore required some 60 to 70 minutes. This had to be modified according to the thickness (L) of the ware as expressed in the approximate figure for the rate of cooling through the annealing range, *i.e.*, $1.3°/L^2$ per minute, leaving 5 per cent. of the breaking stress in the ware.

When discussing the amount of strain permissible in commercial glassware, the author stated that if it were possible so to control a lehr as to alter the rate of cooling and maintain uniformity of conditions, it would be possible to improve the resistance of ware both to thermal shock and internal pressure. Ware stressed in this way up to about 20 per cent. of the breaking stress did not show any lessened resistance to mechanical shock and was certainly more resistant to the two tests mentioned. If this figure were chosen for the desired amount of stress in the annealed ware, it would change the rate of annealing as estimated from $1.3°/L^2$ per minute to $5.2°/L^2$ per minute, and this would give an allowable state of 21° per minute through the annealing range for ware 0.5 cm. in thickness. The amount of heat conducted from one wall to the other in glass was approximately 0.01 calories per second.

A Theory of the Strength of Thermally Toughened Glass. By Dr. J. T. Littleton, Jr., and Dr. F. W. Preston.

Glass that was poorly annealed, or that is deliberately "toughened" by chilling it from above the annealing range, was characterised by having its outer layers in compression and its inner layers in tension. Such poorly annealed or toughened glass might be stronger or weaker than well-annealed glass, according to circumstances. The glass became treacherously weak if any part of the interior zone of tension reached the surface and it was then likely to break spontaneously—hence some writers spoke of "negative hardening" and ascribed it to subtle changes of physical constitution. The author first of all discussed the nature of glass fracture. Flaws in the interior of a piece of glass would need twice as much effort to extend them as would a flaw at the surface. The interior of the glass would be twice as strong as the skin. On this fact depended the merit of "toughened" glass. There was an optimum heat treatment, producing an optimum initial strain, which was such that when the mechanical pull was applied, the limiting strength of the interior and of the surface was reached simultaneously. The optimum heat treatment for

ordinary soda-lime glasses was one which introduced about 3,500 lb. of axial tension, as in such glasses the breaking load was usually about 7,000 lb./sq. inch. This applied to rods under plain tension. The usual test, however, was to take a lath of glass, to place it like a bridge over two supports near the ends, and to break it by bending. A mathematical discussion of this problem was then given, from which it appeared that theoretically, the best possible heat treatment would be to make the glass about 3.4 times as strong as well-annealed glass. The question was considered next in the light of impact tests. The greatest cause of the breakage of glass was that it was hit. Under impact, two new sets of stresses appeared—vibrating stresses and a great concentration of bearing stresses at the point where the impact occurred. This might result in driving a "conical" hole through the glass, or in beginning to do so, whereon a general radiating system of cracks started in all directions. This problem was discussed and references made to experimental results obtained by L. T. Sherwood.

The Strength of Glass Containing Cracks. By LOWELL H. MILLIGAN. (A communication from the Norton Company Research Laboratories, Worcester, Mass., U.S.A.)

Experiments were made to study the travel of cracks through glass. The general procedure was to cut small bars from a pane of window glass. A steel-wheel glass cutter was used to do this and also to mark the bars with a transverse scratch across the centre. Then the bars were subjected to atmospheres of different types, or were wetted with various liquids, and the conditions of time and load under which they would break were studied. The nature of the scratches and the distribution of stress around them were determined by microscopic examinations with ordinary and with polarised light. The experiments showed that, 1. The presence of water in the crack reduced the strength by about 20 per cent; 2. Exposure in air saturated with water vapour reduced the strength considerably. Although the exact magnitude of this effect was not determined, it would seem to be similar to that produced by the liquid water; 3. Bars that were wetted and then re-dried before testing, regained slightly more than their original dry strength; 4 Air saturated with the vapour of absolute alcohol produced an effect similar to that of air saturated with water vapour; 5 The presence of dry paraffin oil in the crack increased the strength by about 20 per cent.; 6 Wetting the crack with a dilute solution of sodium silicate followed by drying increased the strength by about 20 per cent.; 7 The effect of water in decreasing the strength, was practically instantaneous, and therefore these effects were thought to be physical rather than chemical in nature.

MINERALOGICAL SOCIETY.

Tuesday, January 14.

Papers read :—

On the Occurrence of Potassium Nitrate Near Goyder's Pass, McDonnell Ranges, Central Australia. By SIR DOUGLAS MAWSON.

On a New Occurrence of Zunyite near Postmasburg, South Africa. By DR. LOUIS T. MOLL.

Exhibiting Minerals from Broken Hill, Rhodesia, and other Localities. By F. W. ASHCROFT.

Exhibiting Specimens and Photomicrographs of Volcanic Rocks from Kenya Colony. By W. CAMPBELL SMITH.

Forthcoming Events.

ROYAL INSTITUTION.

The Afternoon Lectures at the Royal Institution will be resumed on January 21 at 5.15 p.m., when Dr. F. W. Aston will begin a course of three lectures on Tuesday afternoons on "Isotopes"; on succeeding Tuesdays there will be four lectures by Sir Willian Bragg on "X-Ray Determination of the Structure of Cellulose and Similar Substances"; and four by Dr. Charles Singer on "The Passage from Mediæval to Modern Science." On Thursday afternoons, beginning on January 23, at the same hour, there are to be two lectures by Dr. H. A. Harris on "The Growth of Children in Health and Disease"; one on February 6, by Dr. R. L. Smith Rose, on "Radio Direction Finding by Transmission aud Reception"; and two by Mr. T. A. Joyce on "Architecture and the Industrial Arts of Pre-Spanish America."

The Saturday afternoon lectures at three o'clock will commence on January 25 with two lectures by Professor R. W. Chambers on "Sir Thomas More and His Friends"; followed by two by Mr. W. Rithenstein on "Nineteenth Century Painting in France and England"; and four by Sir Ernest Rutherform on "Atomic Nuclei and their Structure."

The first Friday Evening Discourse will

be on January 24, when Sir William Bragg will give a discourse on "Cellulose in the Light of the X-Rays." Succeeding discourses will probably be given by Lord Rayleigh, Dr. Leonard Hill, Professor A. F. Pollard, Professor G. I. Taylor, Mr. C. Tate Regan, Professor G. Elliot Smith, Mr. Seton Gordon, Sir Ernest Rutherford, and other gentlemen.

ROYAL SOCIETY OF ARTS.

Wednesday, January 22, at 8 p.m.—(Ordinary Meeting.) Gilbert Stone, Barrister-at-Law : "Observations on the Mining Laws of the British Empire." Sir Richard A. S. Redmayne, K.C.B., M.Sc., M.Inst. C.E., will preside.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Tuesday, January 21, at 5.15 p.m.—"Isotopes." By Dr. F. W. Aston, F.R.S.

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INSTITUTE OF RUBBER TECHNOLOGISTS.

Manchester Cafe, Ltd., Exchange Buildings.

Thursday, January 23.—"Some Aspects of Standardisation." By B. D. Porritt.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

38,508.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of vat dyestuffs. December 16.

38,688.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of dyestuffs. December 17.

38,509.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of 2. acylbenzanthrones. December 16.

38,820.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of aromatic acylamino-compounds. December 18.

39,091.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of cellulose esters. December 20.

Specifications Published.

295,593.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of 4-methyl-6-Halogen Hydroxythionaphthenes.

297,123.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of sulphur dyestuffs.

298,087.—Heberlein & Co., Akt.-Ges. Manufacture of acidyl-Cellulose.

Abstract Published.

321,155.—Dyes.—Imray, O. Y., 30, Southampton Buildings, London.—(Soc. of Chemical Industry in Basle, Switzerland).

Cyclammonium polymethine compounds.—Dyestuffs are obtained by oxidising, in a medium which is not alkaline, a condensation product produced : (1) by the action of formaldehyde (1 mol.) upon a methylene base of a cyclammonium salt having a reactive methyl group in the α-position (2 mols.), or (2) by removal of acid, by treatment with alkali, from the product produced from formaldehyde (1 mol.) and a cyclammonium salt having a reactive methyl group in the α-position (2 mols.). In examples, formaldehyde is condensed with 1 : 3 : 3-trimethyl-2-methyleneindolin in alcoholic solution, and the product, dissolved in benzene, oxidised by means of benzoquinone in the presence of acetic acid. The resulting addition product of 1 : 3 : 3 : 1' : 3' : 3'-hexamethylstreptomonovinylene-2 : 2'-indocyanineacetate with hydroquinone may be treated with alkali to give the free base, which yields a hydrochloride on dissolution in dilute hydrochloric acid : (2) lead peroxide is used for oxidation of the same condensation product : (3) methylene-di-quinaldine iodomethylate, prepared from formaldehyde (1 mol.) and quinaldine iodomethylate (2 mols.) in the presence of a small quantity of piperidine, is treated with 30 per cent. caustic soda at 70-80° C., and the base, dissolved in chloroform, oxidised by means of quinone in the presence of acetic acid. The product is probably an addition product of hydroquinone and 1 : 1'-dimethylstreptomonovinylene-2 : 2'-quinocyanineacetate. Methylene bases of trimethylindoleninium salts derived from *o*- and *p*-toluidine or other substitution products or homologues of aniline or of α- or

β-naphthylamine may also be condensed with formaldehyde and then oxidised. The dyestuffs from o- and p-toluidine yield pure bluish red tints on cotton mordanted with tannin while the dyestuffs from β-naphthylamine dye this material violet tints having a reddish fluorescence. Instead of quinone, derivatives of quinone, *e.g.*, 2 : 6-dichlorquinone, or nitroso compounds, metallic oxides and salts, oxygen or air may be used. Formic, propionic, benzoic, sulphuric and hydrochloric acids are mentioned as acids that may be used in place of acetic acid.

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No notice can be taken of anonymous letters.

THE COLLINSICS OF MINERALS. XIV.

By Hawksworth Collins, B.A., (Camb.).

The following twelve collinsics each contain one or more atoms of Pb (the only new introduction) of which the relative volume is 17.42 and the optical refractivity 18.264. The next twelve will each contain one or *more atoms of the same element, of which* the R.V. is 19.81 and the O.R. 35.459. The *last mineral in this paper contains* both these forms of Pb.

The two R.V.'s 17.42 and 19.81 were discovered many years ago, and they were both proved to be exactly true by the Law of Heat of Formation. This matter was demonstrated in the *Chemical News*, 1926, cxxxii, 85, when the structure of lead was under consideration and also in the *Chemical News*, 1926, cxxxii, 246 and 262, when the Law of Heat of Formation was being demonstrated.

For the sake of those scientists who see this matter for the first time, it is necessary as usual to explain one collinsic as an example of all the 168 which have so far been published.

In Matlockite, No. 157, the first line gives the chemical formula and also the theoretical S.G., followed by the experimental S.G., which differ by much less than 1 per cent. The second line gives (between the brackets) the R.V. of each atom in the molecule. When the molecular weight is divided by the sum of these volumes the theoretical S.G. is obtained. The second line also gives the result (79.914) of multiplying the sum of the volumes by $\mu - 1$. The third line gives the theoretical refractive index (μ) of the mineral followed by the experimental value, *which must be within 1 per cent. of one* another. The fourth line gives the O.R. of each atom in the molecule, and also the sum of these values, which must correspond to at least four figures with the product of the second line.

There are three voloptics in this mineral, *viz.*, 17.42 and 28.264, 4.45 and 1.747, 15.085 and 10.82. These are invariable constants at 15° C. in all minerals in which they occur. The three colls in this mineral are 7.184 and 7.2, 2.1505 and 2.15, 79.914 and 79.915. The colls are pairs of values which belong only to the mineral under consideration.

TABLE XIX.
THE COLLINSICS OF TWELVE MINERALS.

	Theor Column.	Obs. Column.	
(157) Matlockite $Pb_2 + O + Cl_2$	**7.184**	7.2	W
79.914 = 1.1505$(\mathbf{17.42_2 + 4.45 + 15.085_2})$			
	2.1505	1.15	N_o. W
79.915 = $\mathbf{28.264_2 + 1.747 + 10.82_2}$			
(158) Pyromorphite			
$Pb_5 + Cl + P_3 + O_2 + O_4 + O_6$	**6.97**	7.0±	W
202.04 = 1.0426$(\mathbf{17.42_5 + 15.085 + 14.56_3 + 7.53_2 + 4.45_4 + 2.51_6})$			
	2.0426	2.05	S
		N_e 2.049	W
202.042 $\mathbf{28.264_5 + 10.82 + 10.51_3 + 1.654_2 + 1.747_4 + 1.346_6}$			
(159) Leadhillite $PbO.PbSO_4.2PbCO_3.H_2O$	**6.514**	6.44	D
		6.547	D
$Pb_4 + O + SO_4 + (CO_3)_2 + H_2O$			
148.482 = 0.9006$(\mathbf{17.42_4 + 4.45 + 35.61 + 20.55_2 + 14.03})$			
	1.9006	1.87-2.01	S
148.483 = $\mathbf{28.264_4 + 1.747 + 11.75 + 7.679_2 + 6.572}$			
(160) Linarite $PbO.CuSO_4.H_2O$	**5.42**	5.3-5.45	D
$Pb + O + Cu + SO_4 + H_2O$			
61.2445 = 0.8319$(\mathbf{17.42 + 4.45 + 7.13 + 30.59 + 14.03})$			
	1.8319	1.83	M
		N_m 1.838	W
61.245 = $\mathbf{28.264 + 1.747 + 13.22 + 11.442 + 6.572}$			

Theor Column. Obs. Column.

(161) Anglesite $Pb + S + O_2 + O_2$

6.443 6.39 D

$40.200 = 0.8577(17.42 + 15.53 + 4.45_2 + 2.51_2)$

1.8577 1.8740 D

$40.200 = 28.264 + 5.75 + 1.747_2 + 1.346_2$

(162) Alamosite $Pb + Si + O + O_2$

6.438 6.49 W

$42.3984 = 0.968(17.42 + 13.83 + 7.53 + 2.51_2)$

1.968 N_m 1.961 W
N_g 1.968 W

$42.39 = 28.264 + 9.78 + 1.654 + 1.346_2$

5.98 5.94 W

(163) Schultenite $H + Pb + As + O + O_3$

$54.31 = 0.9393(5.76 + 17.42 + 19.58 + 7.53 + 2.51_3)$

1.9393 N_m 1.910 W
N_g 1.977 W

$54.319 = 2.613 + 28.264 + 17.75 + 1.654 + 1.346_3$

(164) Ganomalite $Ca_4 + Pb_6 + H_2 + Si_6 + O_{15} + O_8$

5.62 5.57 W
5.7 W

$312.533 = 0.9085(15.54_4 + 17.42_6 + 5.76_2 + 13.83_6 + 4.45_{15} + 2.51_8)$

1.9083 N_0 1.91 Larsen

$312.543 = 10.52_4 + 28.264_6 + 2.613_2 + 9.78_6 + 1.747_{15} + 1.346_8$

(165) Nasonite $Ca_4 + Pb_6 + Cl_2 + Si_6 + O_8 + O_{13}$

5.422 5.43 W

$333.62 = 0.9177(13.25_4 + 17.42_6 + 15.085_2 + 13.83_6 + 7.53_8 + 2.51_{13})$

1.9177 N_0 1.917 Lar.

$333.634 = 13.25_4 + 28.264_6 + 10.82_2 + 9.78_6 + 1.654_8 + 1.346_{13}$

(166) Molybdophyllite

$Pb + H_2 + Mg + Si + O + O_2 + O_2$

4.714 4.72 W

$58.8615 = 0.81616(17.42 + 5.76_2 + 8.71 + 13.02 + 7.53 + 4.45_2 + 2.51_2)$

1.81616 N_0 1.815 W

$58.8615 = 28.264 + 2.613_2 + 6.0015 + 11.53 + 1.654 + 1.747_2 + 1.346_2$

(167) Roeblingite $H_{10} + Ca_7 + Pb_2 ++ S_2 + Si_5 + O_2 + O + O_{25}$

3.423 3.43 W

$254.602 = 0.6436(5.76_{10} + 14.54_7 + 17.42_2 + 15.53_2 + 17.61_5 + 7.53_2 + 4.45 + 2.51_{25})$

1.6436 N_m 1.64 W
N_g 1.66 W

$254.628 = 2.613_{10} + 10.52_7 + 28.264_2 + 5.75_2 + 9.625_5 + 1.654_2 + 1.747 + 1.346_{25}$

(168) *Mimetite* $9PbO.3AS_2O_5.PbCl_2$

$Pb_6 + Pb_4 + As_6 + Cl_2 + O_5 + O_{19}$

7.115 7.0 D
7.15 W

$473.428 = 1.136(17.42_6 + 19.81_4 + 19.58_6 + 15.085_2 + 7.53_5 + 2.51_{19})$

2.136 2.135 W

$473.404 = 28.264_6 + 35.459_4 + 17.75_6 + 10.82_2 + 1.654_5 + 1.346_{19}$

ı Leadhillite (No. 159) the groups SO_4 CO_3 are given as a whole in order that the molecule may be printed in one line, and in No. 160, SO_4 is similarly written. When expanded they are as follow :

TABLE XX.

		S	+	O_2	+	O_2
35.61	=	15.53	+	7.53_2	+	2.51_2
11.75	=	5.75	+	1.654_2	+	1.346_2
		S	+	O	+	O_3
30.59	=	15.53	+	7.53	+	2.51_3
11.442	=	5.75	+	1.654	+	1.346_3
		C	+	O	+	O_2
20.55	=	8.0	+	7.53	+	2.51_2
7.679	=	3.333	+	1.654	+	1.346_2

The discoveries of the Relative Volume of each atom in every molecule, the Law of Heat of Formation, and the Collinsics were all largely dependent upon the discovery of the three forms of oxygen, as follow :—

(A) Acidic oxygen has R.V. 7.53, O.R. 1.654, and H.F. 32341.

(B) Basic oxygen has R.V. 4.45, O.R. 1.747, and H. F. 71515.

(C) Neutral oxygen has R.V. 2.51, O.R. 1.346, and H.F. 96155.

There are very large differences between the three forms, so that it is impossible to mistake them for one another.

The R.V. and H.F. of each form have been frequently demonstrated in the *Chem. News* in numerous papers during the last six years.

S = Smithsonian Publication.

W = Winchell.

D = Dana.

N_o = Index of refraction for the ordinary ray.

N_e = Index of refraction for the extraordinary ray.

N_m = Intermediate (mean) index = β of German writers.

N_g = Greatest index = γ of German writers.

In a former paper it was explained that *the Lorentz formula for Optical Refractivity* leads to nothing whilst the Gladstone-Dale formula leads to numerous ever-increasing truths regarding the Constitution and Structure of Atoms. So the former has been entirely discarded by the author. Any reference to it in former papers should be ignored.

For the benefit of those scientists who are continually suggesting that such discoveries as the collinsics are merely armchair speculations, the fact is that there is no speculation, *i.e.*, guesswork anywhere in them. If they think there is, it seems to be necessary that they should state exactly where they think the speculation comes in. It is a cosmopolitan and thankless task which cannot be done in an armchair. It is the Higher Research Work which is infinitely harder than ordinary experimental work. It must be more difficult and therefore higher than ordinary research work, because it is built upon the experimental work of all scientists.

In order that a man may do this work, he must first of all have a mathematical mind. He must secondly have a respectable knowledge of chemistry, thirdly of mineralogy, fourthly of physics, fifthly of logic. Any scientist who attempts to criticise the collinsics and who has not a fairly good knowledge of each one of the above sciences is incapable of judging whether the collinsics are true or false.

Whenever water of crystallisation occurs in a mineral its relative volume at 15° C. is always 14.03 = 5.76_2 + 2.51, and its O.R. is 6.572 = 2.613_2+ 1.346

TOBACCO HEART DANGERS.

Twenty per cent. of the youths applying for employment with the South Metropolitan Gas Company have been found to be suffering from "tobacco heart."

Dr. Charles Carpenter states this remarkable fact in a New Year message issued to the co-partner employees of the company, of which he is president. Stressing the need for improving the physical fitness of the workers, and for examination of the human machine where it is suspected of failing, he states that with that end in view the directors installed on the premises a cardiograph instrument which, just as the steam indicator enabled one to verify the working of an engine, enabled the physician to observe the human heart. The cardiograph, applied to prospective employees had revealed the wide prevalence of the "tobacco heart" among youths of to-day.

"We shall certainly not be able," says Dr. Carpenter, "to build up an A1 nation from such material, nor would a gasworks be a suitable place to try to do so. The Company's desire is to pay 'healthy' wages, and it is surely entitled to expect a healthy service in return."

SOUTH AFRICAN ELECTRICITY SUPPLY REGULATIONS.

H.M. Senior Trade Commissioner in South Africa has forwarded copies of the Electricity Supply Regulations for the City of Capetown and the Municipality of Port Elizabeth.

Copies of the Regulations are available for loan to British firms, in order of application, to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

A NEW CONCEPTION OF RELATIVE CONFIGURATION.

By Charles Edmund Wood and Sydney Diggary Nicholas.

(*University of Birmingham.*)

(*Continued from page 41.*)

Consideration of a Molecular Model and Evidence for the Irregular Tetrahedron.

The foregoing explanation of relative configuration and dispersion confine the phenomenon to the molecule and not to isomeric molecules.

Thomson (*loc. cit.*) also has shown that change of sign of rotation without change of configuration can be deduced from considerations involving only one molecule. His model consists of two parts: (*a*) the four atoms at the corners of an irregular tetrahedron, (*b*) four electrons which bind the atoms to the asymmetric carbon atom, and so results an electronic and an atomic tetrahedron. He proves that it is the response of the electronic tetrahedron that accounts for the major part of the rotatory dispersion in the visible region. By an extension involving, instead of four, eight coupling electrons, which are in accordance with modern views, two electronic tetrahedra would result; their unequal* displacements in opposite directions would give rise to positive and negative rotatory dispersion and as a resultant effect anomalous rotatory dispersion. His general equation applies equally to the crystalline state, accordingly the X-ray analysis of tartaric acid (Astbury, *Proc. Roy. Soc.*, 1923, [A], CII, 506) and of quartz (Bragg and Gibbs, *Proc. Roy. Soc.*, 1925, [A], CIX, 405; 1926 CX, 443) are of interest.

On the views put forward the activity of tartaric acid is due to the deflections of the atomic groups round the asymmetric centres (irregular tetrahedra resulting) which deflections give rise to the carbon and, oppositely directed, hydroxyl spirals formed by the two molecules in the space lattice. That the spirals are the result and not the cause of the deflections is supported by experimental evidence which is unfavourable to the view that the anomalous rotatory dispersion of tartaric acid and its derivatives both in the fused state and in solution can be attributed to spiral formation due to molecular association. The deflections are the cause of anomalous rotatory dispersion both in solution and in the crystalline state [Cf. d-potassium rhodium oxalate which exhibits anomaly both in solution and in the crystalline state. X-ray analysis (Burgess, *Proc. Roy. Soc.*, 1927, CXVI [A], 553), reveals spiral formation in the crystalline state, that is a special arrangement of atoms within a unit of structure. Passage from the crystalline state to solution has little effect on the anomaly, accordingly, spiral formation is a result and not the cause of the anomaly.] In addition X-ray analysis has failed to reveal more than one molecular species.

In Quartz the silicon atom is surrounded by four oxygen atoms† in such a way that an irregular tetrahedron results and these tetrahedra give rise to a spiral. Each set of four oxygen atoms function as four or maybe two different groups; that the seat of the rotatory power is centered in these tetrahedra, the silicon atom being the active centre is borne out by the work of Bragg and Gibbs. They conclude that the effect of raising the temperature above the transition temperature reduces the hindrance to greater freedom of movement due to the crystalline state and the tetrahedra become approximately regular when α-quartz passes into β-quartz. The great decrease in rotatory power which accompanies this change should accordingly be ascribed to the increased symmetry of the tetrahedra and definitely confirms the view that the silicon atom is the active centre. As would be expected complete loss of rotatory power occurs on fusion.

Apart from the physical treatment and X-ray analysis rotation data supports the view that the angles between the valency directions of the four atoms or groups round an asymmetric centre will be different, due to the four frequencies arising from each pair of coupling electrons. The straight chain hydrocarbons exhibit a zig-zag structure (Muller, Shearer, *Trans.*, 1923, CXXIII, 2043) there being no asymmetric centre to cause preferential deflections. When, however, such a chain is the ester grouping of an optically active α-hydroxy acid (or a long alkyl grouping of an optically active carbinol) a periodic variation occurs in the rotation values at definite increments in the chain, which fact implies no longer a zig-

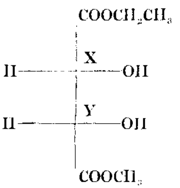
* This inequality due to the molecule being asymmetric, *i.e.*, of "d" or "l" configuration gives rise to the restrictions that make anomalous rotatory dispersion a configuration criterion.

† Lewis ("Valence and the Structure of Atoms and Molecules," 1923, p. 94) on his valency conceptions regards silica as a polymerisation product, the silicon being tetravalent (*cf.* Lowry, *J. S. C.I.*, 1927, XLVI, 78).

zag structure but a deflection causing a helical spiral formation.

Thus the cause of anomaly has been brought down not only to one molecule but to an active centre or centres in the molecule and where more than one centre occurs the final configuration of the molecule is the resultant effect of all the centres. If n asymmetric centres exist in the molecule, there will be $2n$ electronic and n atomic arrangements.§ Should all the centres be "d" centres the resultant configuration would be "d." If however some of the centres be "d" and some "l" the resultant effect will be "d" or "l" according whether $\lesseqgtr$ "d" centres dominates over $\lesseqgtr$ "l" centres or *vice versa*. The mere numerical summation of "d" and "l" centres will not reveal whether the resultant configuration is "d" or "l."

In meso-tartaric acid the two centres are equal and opposite but I will be active and whether "d" or "l" depends on which centre X or Y is dominant.



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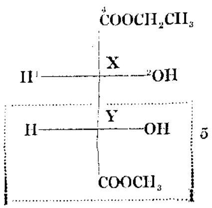

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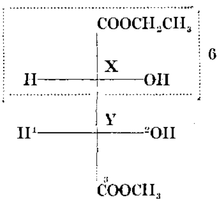

III

Assuming the order of frequencies to be

$$\underset{1}{C-H} > \underset{2}{C-OH} > \underset{3}{C-COOCH_3} >$$

$$\underset{4}{C-COOCH_2CH_3} > \underset{5}{C-CH(OH)COOCH_3} >$$

$$\underset{6}{C-CH(OH)COOCH_2CH_3}$$

in II, X would be a "d" centre and in III Y an "l" centre and since the contrast between frequency 6 and frequency 3 is greater than that between 4 and 5, the dominence would be "l", for the "l" centre Y would be stronger than the "d" centre X and the resulting dissymmetry of the molecule would be that corresponding to an "l" compound. Another way of looking at the matter is as follows, the C-H and C-OH frequencies taken in pairs, from symmetry balance one another but the $C-COOCH_3$ frequency being greater than the $C-COOCH_2.CH_3$ frequency, the molecule will be distorted into a dissymmetric shape corresponding to an "l" compound and the order of frequencies round the double centre will be
(1) C-H. (2) C-OH. (3) $C-COOCH_3$. (4) $C.COOCH_2.CH_3$
in accordance with a compound of "l" configuration.

In conclusion, an interpretation of anomalous rotatory dispersion as a criterion of configuration has been put forward and this new aspect justifies Winther's conviction of twenty-five years ago that the study of dispersion data should bring to light peculiar and fundamental properties of optically active compounds.

§ Not necessarily tetrahedra when active centres other than asymmetric centres are considered. In co-ordination compounds octohedra, etc., may be concerned. In certain dissymmetric molecules also the form may be some other irregular geometrical figure.

Summary.

1. Winther advocated in 1905 the determination of rotatory dispersion as a promising method for the study of chemical constitution and Lowry in 1912 established such measurements on a quantitative basis.

2. Visual anomaly in the positive region is characterised by (*a*) inflexion (positive region), (*b*) maximum (positive region), (*c*) crossing of the axis $d\alpha/d\lambda$ positive singly or together; conversely, for the negative region. Dispersion giving rise to visual anomaly in the positive region can be ex-

pressed by a two term Drude equation in which the high frequency term is positive, *the low, negative. When the rotational constant* of the high frequency term is less than that of the low frequency term the curves are confined to the negative region and no *longer exhibit visual but potential anomaly.* An extensive survey of the literature reveals no instance of a compound exhibiting anomaly both in the positive and negative region.

3. The restrictions on the region of anomaly make anomaly a criterion for relative configuration. The three inter-related characteristics of visual anomaly are each sufficient to determine the region and hence the configuration. In the case of potential anomaly analysis of the dispersion curve into high and low frequency terms must be resorted to.

4. The inter-relationship of the two methods for defining relative configuration, *viz.*, the generic, which depends on chemical transformations, and the empirical, which depends on cumulative comparative data, has been discussed.

5. The generic definition is restricted to compounds the geneology of which can be traced by a chain of chemical transformations. Apart from certain α-hydroxy acids and the carbohydrates the definition has no meaning.

6. Empirical methods lead to contradictory results. They are only applicable generally to closely related acids and break down when applied to other series.

7. It was not realised that two conceptions were in use when configuration was defined by the generic and empiric methods. The generic method was a purely geneological method; empiric methods are an attempt to place compounds in enantiomorphic series.

8. A general definition of configuration (choosing the enantiomorphic conception of configuration) is made based on the criterion of anomaly. The conception postulates an *irregular tetrahedron.*

9. The Drude equation for the dispersion of quartz requires an infra red term. Organic compounds give, compared with Quartz, *relatively small rotations and so extreme* refinement in measurement may be necessary to prove its contribution to the dispersion in the visible region. There is no justification *for placing* Quartz in a class by itself.

10. Thomson's theoretical deductions are considered with respect to rotation and to the irregular tetrahedral shape and an explanation of anomaly has been given which is based on a modification of his model.

11. X-ray analysis of tartaric acid and quartz, also rotational data of optically active esters and alcohols containing an extended alkyl grouping show that spiral formation arises from deflections round an *asymmetric centre or centres.*

Chemical Department,
University of Birmingham.
Edgbaston.

THE BEHAVIOUR OF COLLOIDAL PARTICLES AT AN ELECTRODE.

By Masuzo Shikata and Nobushige Hosaki.

The behaviour of colloids, such as gelatine, at an electrode has been one of the problems in electroplating. But it seems to us that the discharge of colloid has not been much *studied. The present authors, in considering* the electric power efficiency of the electro-osmotic drying of peat, found it to be desirable to determine the discharge potentials *of colloidal particles, if such potentials* do exist.

We measured the effect of colloids on the deposition potentials of metallic ions, such as Li, Na, K and Pb at the dropping mercury cathode with the polarograph (*Rec. Trav. chim. Pays-Bas*, 1925, XLIV, 496), because this method has proved to be suitable for the microanalysis of metallic ions so minute as 10^{-1} to $10^{-?}$ mols of their concentrations.

It has *been found that in decinormal* salt solution, the deposition potential of the sodium ion is 1.913 V (from 2 *N* calomel electrode), in the presence of 0.1 per cent. gelatine is -1.735 V, and in the presence of 0.1 per cent. agar agar is -1.863 V, that is, the deposition potential of sodium ion has become positive by 0.178 V with gelatine and positive with agar agar by 0.050 V.

In general the deposition potentials of alkali metals incline to positive in the presence of gelatine and agar agar.

WILD-BARFIELD ELECTRIC FURNACES, LTD.

Messrs. Wild-Barfield Electric Furnaces, Ltd., have entered into an agreement with Messrs. Gibbons Bros., Ltd., of Dibdale Works, Dudley, for the manufacture of large Wild-Barfield Industrial Electric Furnaces.

AN ANALYSIS OF THE ARC AND SPARK SPECTRA OF YTTRIUM (Yt I and Yt II)

By William F. Meggers and Henry Norris Russell.

(*U.S.A. Bureau of Standards.*)

All the available data (wave-length measurements and intensity estimates, temperature classes, Zeeman effects) on yttrium lines have been correlated and interpretated in an analysis of the arc and spark spectra. The total number of lines classified is 448 in the Yt I spectrum, 223 in the Yt II spectrum, and 10 in the Yt III spectrum.

Series-forming terms have been identified in each of the spectra, and from these the ionisation potentials of 6.5 volts for the neutral Yt atom, 12.3 volts for the Yt+ atom, and 20.6 volts for the Yt++ atom have been deduced.

Yttrium is a chemical analogue of scandium, and the corresponding spectra are now seen to be strikingly similar. A ^{2}D term (from a *d* electron) represents the lowest energy (normal state) of both Sc III and Yt III, and another ^{2}D (from the s^2d configuration) describes the normal state of Sc I and of Yt I. The configurations which do not contain a *d*-electron are much lower in Yt II than in Sc II; a consequence of the fact that the *s* and *p* states in Yt III are lower compared with the *d* state than in Sc III. This results in $^1S_0$ (s^2) as the normal state for Yt II, while it is ^{3}D (*sd*) for Sc II.

The analyses of Yt I and Yt II spectra are supported by measurements of Zeeman effects, which are interpreted with the aid of Landé's theory of Zeeman effects and multiplet structure. All details of the three spectra, Yt I, Yt II, and Yt III, are in accord with Hund's correlation of spectral terms with electron configurations.

BRITISH OVERSEAS TRADE IN 1929.

Imports of merchandise last year exceeded, by nearly £26 million in value, or 2.1 per cent., those of 1928, the advance being greatest in goods wholly or mainly manufactured — above £16¼ million. Exports of British produce and manufactures were larger in value by close upon £6 million, or 8 per cent. above the previous year, and by nearly £20¼ million over 1927. A rise of over £9½ million in coal shipments was, however, more than offset by the fall in exports of cotton goods.

PRODUCTION OF NICKEL AND GOL IN CANADA.

The Dominion Bureau of Statistics a Ottawa, estimates the value of the Canadia mineral output for 1929 at 303,876,0 dollars, which is 10.5 per cent., 28,876,000 dollars above 1928 and is t highest on record.

The metals group produced 151,327,0 dollars, which is 14.6 per cent. higher.

Fuels produced 76,116,000 dollars, whic is 3 per cent. higher.

Other non-metallics are valued 21,205,000 dollars, which is 12.6 per cen higher.

Quarried building materials are value at 55,228,000 dollars, which is a gain of 1 per cent.

In order of monetary values the leadin mineral products of Canada were coal, co per, gold, nickel, cement, lead, asbesto clay products, silver, zinc, stone, natur gas sand, gravel, lime, petroleum, gypsun cobalt, salt, and platinum metals, the valu of which all exceeded a million dollars.

In addition some fifty other minerals we mined in commercial quantities in 1929.

Canada now produces 90 per cent. of th world's nickel, 85 per cent. of asbestos, 5 per cent. of cobalt, 8.0 of lead, 8.4 of silve 6.4 of zinc, and 4 per cent. of the world' copper.

Coal production was 17,500,000 ton slightly lower than 1928.

Copper production, which was the highes on record, was 242,402,000 pounds, wort 43,362,000 dollars, which is 20 per cent. in crease in volume and 52 per cent. increas in value. Of this, British Columbi produced 103,000,000 pounds, Ontari 84,000,000 pounds and Quebec 55,000,00 pounds.

Gold production showed a gain of 1. per cent. with a total output of 1,915,00 fine ounces valued at 39,585,000 dollars Ontario yielded 1,606,000 ounces. Th Porcupine gold field in Northern Ontari is still the principal producer with 925,00 ounces, which is slightly lower than 1928. The Kirkland Lake area showed an increas of 672,000 ounces. There were slight increases also in the Provinces of Quebec, Manitoba, and Nova Scotia, and a decrease in British Columbia.

Nickel production was 109,000,000 pounds worth 25,700,000 dollars, which is a 13 per cent. increase in quantity and 15 per cent. increase in value from 1928. A notable nickel development is proceeding in the Sudbury, Ontario, area.

Cement production was 12,000,000 barrels, worth 19,595,000 dollars, which is an increase of 17 per cent. in value from last year, reflecting the growth in building construction.

Lead production was valued at 327,062,000 pounds, worth 16,551,000 dollars, a decrease of 3 per cent. in quantity but an increase of 6 per cent. in value as compared with 1928.

Asbestos production amounted to 205,000 tons, worth 13,000,000 dollars, which is a 12 per cent. increase in quantity and an 18 per cent. increase in value. Exports of raw asbestos are decreasing, while fabricated asbestos is increasing.

The value of clay products during the current year was 13,000,000 dollars, which is 5 per cent. greater than in 1928.

Silver production was valued at 22,368,000 fine ounces, worth 11,870,000 dollars, showing an increase in quantity but a 7 per cent. decrease in value as compared with 1928. The production of silver in Ontario and the Yukon was greater, but was lower in Quebec and in British Columbia.

Zinc production was 10 per cent. greater in quantity and value at 204,000,000.

Stone, sand, gravel and lime production reached a value of 22,000,000 dollars, which is a 10 per cent. increase.

The production of natural gas increased by 8 per cent. at 9,202,000 dollars.

The greatest gain was in Ontario. Petroleum production totalled 1,032,000 barrels, worth 3,945,000 dollars, which was an 82 per cent. increase in quantity and 94 per cent. increase in vaue. Alberta produced about 1,000,000 barrels.

The oil and natural gas industry is now centred in Western Canada, and the production in Ontario and New Brunswick continues on only a moderate scale.

Gypsum production was 1,256,000 tons, worth 3,666,000 dollars, which was 2 per cent. better than in 1928.

The programme for the construction of plants for mining companies are extensive and expansion of mining and smelting is expected in 1930, particularly in regard to nickel and copper.

An increase is also expected in lead and zinc if prices hold.

The gold production will be well maintained and some increase is indicated in silver.

As a whole non-metallics promise a prosperous year and there is no prospect of a decline in the production of other minerals.

GENERAL NOTES.

TRADE IN DECEMBER, 1929.

In December, 1929 the total value of the imports of merchandise was £5,123,000 more than in December, 1928. There was an increase of £1,478,000 in food, drink, and tobacco, notwithstanding a decrease of £1,903,000 in the imports of grain and flour. The increases were principally in meat (£1,187,000), butter (£519,000), eggs (£353,000), and canned fish (£517,000). Imports of raw materials increased by £311,000. The principal increases were in wool (£1,182,000) and paper-making materials (£516,000), while imports of cotton declined by £2,168,000. There was an increase of £3,386,000 in manufactured articles, this increase being general over the whole class with the exception of silk manufactures, paper, and motor cars.

As compared with November, 1929, the imports in December were less in value by £1,643,000, the only class to show an increase being that of raw materials.

British exports were £1,964,000 less in value in December, 1929, than in December, 1928, the decrease occurring almost entirely in manufactured articles. Manufactures of cotton declined by £1,121,000, manufactures of wool by £473,000, and manufactures of other textile materials by £423,000, while exports of wool were less by £465,000. Coal showed an increase of £900,000, and chemicals of £547,000. Exports of vehicles were less by £471,000 owing to smaller exports of new ships.

The reduction of £4,695,000 in the value of British exports in December, 1929, as compared with the preceding month, was made up of reductions of £716,000 in food, drink, and tobacco, £715,000 in raw materials, and £4,028,000 in manufactured articles, partly offset by increases of £710,000 in parcel post, and of £54,000 in animals not for food.

Re-exports of imported merchandise were less than in December, 1928, by £1,141,000, the reduction being almost entirely in raw materials, the principal items contributing to the decrease being hides and skins £532,000) and rubber (£352,000). The most important changes, as compared with the month of November, 1929, were an increase of £1,217,000 in wool and a decrease of £705,000 in hides and skins.

CHEMILUMINESCENCE.

Among the important bulletins issued by the U.S. National Research Council is the Report on Chemiluminescence by a sub-committee under the chairmanship of Prof. E. Newton Harvey.

The Report (*Bulletin No. 59 : Chemiluminescence*. National Research Council of the Washington Academy of Sciences. Pp. 62. 1927. Price 50 cents) brings together the facts and theories on the subject and includes the following sections :—

Types of Chemiluminescence. By Allan D. Garrison; *Experimental Methods used in the Study of Luminescence.* By A. H. Pfund; *Energetics, Spectra, Intensity and Efficiency of Chemiluminescence.* By Elliot Q. Adams; *Photochemistry and Chemiluminescence—Kinetics of Chemiluminescence.* By Hugh S. Taylor; and *Bioluminescence.* By E. Newton Harvey.

It may be pointed out that the term "Luminescence" is now applied to all *forms of light production other than pure* temperature radiation. Such prefixes as photo-, thermo-, pyro-, electro-, cathodo-, anodo-, radio-, crystallo-, tribo-, organo-, and chemi-luminescence denote the manner in which the light has been produced. Fluorescence and phosphorescence have been classed as photo-luminescence and the 'delayed' phosphorescence which occurs on slight heating has been called thermo-luminescence. Light emitted by radioactive substances has been termed radio-luminescence, etc.

Chemiluminescence is defined as the light which results from chemical action and naturally includes a large range of phenomena and the Report is concerned with an account of the present state of knowledge concerning the various manifestations of chemiluminescence, the best methods of studying the subject, its significance and the application of the knowledge to wider fields, notably in biological processes.

PROFITS TAX ON FOREIGN BANKS ESTABLISHED IN SPAIN.

H. M. Ambassador in Madrid has drawn attention to the publication in the *Madrid Gazette* of December 6 of a Royal Decree, dated November 26, 1929, which modifies the regime under which foreign banks established in Spain are assessed for profits tax.

A translation of the Royal Decree has been furnished and can be consulted at the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

OVERSEAS TRADE.

The Department of Overseas Trade announce that Mr. Spencer Stuart Dickson, *His Maesty's Minister to the Republic of* Colombia, who will shortly proceed to his *post, will be in attendance at the offices of* the Department of Overseas Trade on January 23, 24 and 27, and is prepared to interview firms interested in business with that Republic.

Firms desiring interviews with Mr. Dickson should apply to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1., quoting the reference 3582/30.

RESEARCH FELLOWSHIPS IN METALLURGY AND MINING.

At The School of Mines and Metallurgy, University of Missouri.

In co-operation with the United States Bureau of Mines and the State Mining Experiment Station, the School of Mines and Metallurgy of the University of Missouri offers four fellowships. These fellowships are open to graduates who have the equivalent of a Bachelor of Science degree and have had the proper training in mining, metallurgy, or chemistry, and who are qualified to undertake research work. The income of each fellowship is $800 for ten months beginning September 1, 1930. Fellows pay fees amounting to approximately $42 per year.

Fellows will register as students in the School of Mines and Metallurgy of the University of Missouri, and become candidates for the degree of Master of Science (unless *this or an equivalent degree* has been earned). Their class work will be directed by the heads of the departments of instruction, but about half of their time will be spent in research work under the direction of the Bureau of Mines staff resident at the School of Mines. *The purpose of this work* is to undertake the solution of definite problems *confronting the mining* and metallurgical industries of the State of Missouri. For 1930-31 *the four fellowships will be* granted in the following subjects: Ore Dressing : *Problems in Gravity Concentration*, Flotation, Ball Milling, and Magnetic Concentration.

Applications, with a certified copy of collegiate record, statement of professional experience, and names and addresses of three references will be received up to June 15, 1930. The application should be addressed, Director, School of Mines and Metallurgy, University of Missouri, Rolla, Missouri.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, January 16.

Papers read :—

The Composition of Diphtheria Toxin—Antitoxin Floccules. By J. R. Marrack and F. C. Smith. Communicated by Sir Charles Martin, F.R.S.

The floccules formed by diphtheria toxin and antitoxin closely resemble serum pseudoglobulin. The ultra-violet absorption curves of the floccules and pseudoglobulin are identical.

The amount of precipitate obtained from a balanced mixture of a given toxin and antitoxin is to a large extent independent of the conditions under which flocculation takes place, particularly of the amount of non-specific protein present.

Lipoid material forms a very small fraction of the floccules. We consider that the floccules consist mainly of antitoxin, and infer that antitoxin is not merely carried down in the pseudoglobulin fraction but actually is pseudoglobulin.

The Delayed Lethal Effect of Radium on Tissue Cultures in vitro. By F. G. Spear. Communicated by Sir Frederick Andrewes, F.R.S.

Cultures *in vitro* of the choroid and sclerotic of embryo chicks were exposed for varying periods to gamma rays from radium and were subsequently subcultivated every 48 hours.

In one series of experiments cultures were exposed to 100 mg. radium (filtered through 0.5 mm. platinum) at a distance of 0.5 cm. In a second series 300 mg. radium was used under the same conditions.

When a delayed lethal effect followed exposure to radium, it occurred sooner in those cultures which had been exposed to the greater intensity of irradiation for a shorter time than in those subjected to a lesser intensity for a longer time, the product of milligrammes of radium and hours of exposure being the same in a given comparison.

The Vascular Filaments on the Pelvic Limbs of Lepidosiren, their Function and Evolutionary Significance. By J. T. Cunningham. Communicated by Prof. E. W. MacBride, F.R.S.

Papers read in title only :—

The Integration of Plant Behaviour. I. Separate Geotropic Stimulations of Tip and Stump in Roots. By Sir Frederick Keeble, F.R.S., M. G. Nelson and R. Snow.

In seedlings of *Zea Mays*, a geotropic stimulus can be transmitted across a discontinuity from a coleoptile tip or root tip to an unstimulated root stump.

Conversely, the sensitivity to gravity of a geometropically stimulated root stump is increased by an unstimulated coleoptile tip placed upon it, and probably also by an unstimulated root tip.

Cellular Individuality in the Higher Animals, with Special Reference to the Individuality of the Red Blood Corpuscle. By Charles Todd. Communicated by S. R. Douglas, F.R.S.

Examination of the Fine Structure of Wool by X-ray Analysis. By J. Ewles and J. B. Speakman. Communicated by Prof. R. Whiddington, F.R.S.

Photographs have been obtained showing for the first time that wool has a definitely fibred structure. The three types of wool investigated in the unstretched state suggest an interesting transition in structure. Cotswold wool has definitely ordered structure, and its strongly fibred pattern indicates an elongated cell. Geelong 80 merino wool, though fibred, is less so than that of Cotswold wool, and suggests an ellipsoidal cell : 64 merino wool shows only a trace of ordered arrangement and fibring. We suggest that these three types are significant of the development of crystalline structure in wool and of its cause .

It seems probable from other evidence that the wool cell begins its existence as a spherical cell of gelatinous material. It may be supposed, if conditions of growth are such as to develop from this spherical cell one elongated in the direction of growth, strains will be set up which will give rise to ordered and preferential arrangement, tending to the crystalline state.

THE CHEMICAL SOCIETY.

Thursday, January 16.

The Heats of Association of Acetic Acid and Heptoic Acid in the Vapour State. By Miss T. M. Fenton and W. E. Garner.

Acetic acid and heptoic acid have been shown to be associated in the vapour state and the heats of association have been calculated. A modified form of the Ramsay and Young apparatus was used. For acetic acid $Q_v = 13{,}790$ cal./g. mol. over the range of temperature 110—184° C. For heptoic acid, Q_v appears to vary with temperature; the average value between 185° and 230° C. is 7,050 cal./g. mol. Since the heat of evaporation of acetic acid is only 5570 cal./g. mol., it is concluded that the double molecules

are held together by forces analogous to those of chemical combination.

The Variation of Phenol Coefficients in Homologous Series of Phenols. By C. E. Coulthard, J. Marshall, and F. L. Pyman.

A systematic study of the variation of the phenol coefficients in the homologous series of p-*n*-alkyphenols, 4-*n*-alkyl-*m*-cresols, 5-*n*-alkyl-*p*-cresols, 3 and 5-*n*-alkyl-*o*-cresols, and 4-*n*-alkylguaiacols has shown that the phenol coefficients of the alkylphenols are in general considerably less than those of the corresponding *n*-alkylcresols, whilst the values of the *n*-alkylguaiacols are comparatively trivial. In all series the phenol coefficient reached a maximum at the *n*-amyl-derivative.

10-*Chloro*-5 : 10-*Dihydrophenarsazine and its Derivatives. Part XII. Further Experiments in the Investigation of the* 1- *and* 3-*Methyl-derivatives.* By C. S. Gibson and J. D. A. Johnson.

In continuation of previous work, 10-chloro-3-methyl-5 : 10-dihydrophenarsazine has been synthesised by an alternative method.

Properties of Conjugated Compounds. The Formation of Bimolecular Reduction Products of Butadiene Acids. By C. M. Cawley, J. T. Evans, and E. H. Farmer.

In the reduction of butadiene acids, esters and ketones by metals, the simple dehydrogen derivative is usually partly or wholly replaced by a bimolecular dihydrogen derivative.

The Isomerism of the Butylideneacetones. By E. N. Eccott and R. P. Linstead.

Geometrical isomerism about a double bond similar to that of the crotonic acids has now been observed in simple unsaturated ketones : thus, both *n*- and *iso*-butylideneacetone (I and II) exist in two forms. The preparation and interconversion of the two pairs of isomerides and their relationship with the corresponding $\beta\gamma$-ketones (III and IV) have been studied.

$CH_2Me.CH_2.CH : COMe$ (I)
$CHMe_2.CH : CH.COMe$ (II)
$CH_2Me.CH : CH.CH_2.COMe$ (III)
$CMe_2 : CH.CH_2.COMe$ (IV)

MINERALOGIAL SOCIETY.

Tuesday, January 14.

The following papers were read by Dr. L. J. Spencer :—

On the Occurrence of Potassium Nitrate near Goyder's Pass, McDonnell Ranges, Central Australia. By Sir Douglas Mawson.

The nitre occurs as encrustations on the walls and impregnations in the wall-rock, in small cases in dolomitic limestone. The roof of the caves consists of a case-hardened crust formed by superficial silicification and ferruginisation of the limestone; and it is this impervious crust that has enabled the nitrates, probably of animal origin, to be preserved. Mention is made of some other occurrences of mineral nitrates in Australia.

A New Occurrence of Zunyite near Postmasburg, South Africa. By Dr. Louis T. Nel.

The mineral zunyute, previously known only from Colorado, has been found in some abundance in altered, highly aluminous shales and flagstones in the vicinity of the deposits of manganese ore of the Postmasburg District in Cape Province. Minute perfectly developed tetrahedra are aggregated in clusters or are disseminated through the rock, which contains also diaspore, kaolin, and leverrierite. Most of the tetrahedra are simple, but a few are interpenetration twins with a triad axis as twin-axis. Analyses agree with the formula $Al_8(OH,F,Cl)_{12}(SiO_4)_3$.

Mr. F. N. Ashcroft exhibited minerals from Broken Hill, Rhodesia, and from other localities; and Mr. W. Campbell Smith exhibited specimens and photomicrographs of volcanic rocks from Kenya Colony.

INSTITUTION OF ELECTRICAL ENGINEERS.

New Graduates.

The Institution of Electrical Engineers issues the following list of successful candidates in the Graduateship Examination, held in November, 1929 :—

*Whole Examination.—Baldwin, C. S. S. (Manchester); Bates, H. O. (London); Batley, H. (London); Bevan, P. A. T. (Abertillery); Boydell, N. (Southport); Brockbank, J. B. (Wolverhampton); Brown, W. J. (Altrincham); Buckley C. F. (Malta); Butterworth, H. (Manchester); Capp, P. F. (Luton); Castellan, G. E. (Rugby); Charlton, T. H. (Manchester); Clift, R. C. (Plymouth); Cowlishaw, A. (Sheffield); Daines, S. A. (Bedford); Deason, J. N. (London); Ellwood, P. (Rugby); Evans, T. (Ebbw Vale); Ferris, G. T. (Plymouth); Fielding, A. L. (London); Flint, E. F. (London); Gartside, A. (Bromsgrove); Gent, A. (Accrington); Godden, F. W. (Cheltenham); Goodyer, K. S. (Coventry); Haldane ,H. R. (London); Hall, W. G. E. (Erith); Hawken, J. J. (Plymouth); Heath, F. E. (London);

Hegan, A. (Lancaster); Helm, L. R. D. (Skipton); Hollingworth, J. E. R. (London); Holroyd, B. N. (Manchester); Isterling, J. (Liverpool); Just, E. J. (Norton-on-Tees); Lewis, G. E. H. (Bakewell); Lloyd, J. L. (Heswall); Loveluck, J. H. N. (Ingol); Lund, G. (St. Helens); Lusty, H. H. (*Ashton-upon-Mersey*); Maie, A. J. (London); Marshall, H. F. (Leamore, Walsall); Maxwell, R. G. (Dublin); Meyer, L. W. (London); Mittra, M. G. (Stafford); Morley, C. G. L. (London); Morris, C. H. (Birmingham); Moss, J. L. (Barking); Palmer, E. B. (*Smethwick*); Parsonage, S. H. (London); Philip, M. (London); Phillips, J. D. N. (Hayes, Middlesex); Platt, L. K. (Blackpool); Raybould, S. (Birmingham); Spruce, A. M. (Walsall); Stahl, H. C. (Manchester); Swinney, J. (Manchester); Thomson, M. F. (London); Tudball, F. C. (Manchester); Vickers, H. E. (Hull); Vine, H. A. E. (Manchester); Walters, F. (Burton-on-Trent); Ward, E. (Farington); Watts, J. L. (Birmingham); Wilkinson, A. B. (Leigh, Lancs); Withers, A. S. (Dewsbury); Woodcock, V. (Birmingham); Woodroffe, D. N. (*Castle Bromwich*); Yardley, A. A. R. (Edinburgh).

* This list also includes candidates who are exempt from, or who have previously passed, a part of the examination and have now passed in the remaining subjects.

PASSED PART I. ONLY.—Allen, R. G. (Manchester); Bilson, F. W. (Wolverhampton); Cole, F. J. (London); Geach, E. A. (Chichester); Halstead, F. J. (Chesterfield); Lash A. R. (Caernarvon); Martin, A. J. (Eynsford); Matthews, T. F. (Tredegar); Palmer, E. H. K. (Harrow); Ridler, P. H. (Darwen); Saville, J. (Dresden, Stoke-on-Trent).

PASSED PART II ONLY.—Galloway, J. (London); Mullane, A. J. (Cardiff); Snelling, C. A. (Ystrad Mynach); Viant, J. R. (Southampton).

We have received a copy of a new booklet dealing with the Salermo low temperature process of coal distillation. It contains much new matter relating to the nature and use of the products obtained when coal is subjected to low temperature treatment, and it also describes possible future developments in this field. Incorporated in the booklet is also a design of the new Salermo Retort, which is now being introduced into industry.

PROF. HACKH'S DICTIONARY OF CHEMISTRY.

I.

From time to time Prof. Ingo W. D. Hackh (San Francisco College of Physicians and Surgeons, California), has published in *The Chemical News* important contributions to chemical science. He has interested himself especially in correlating the experimental data on which some of the more fundamental generalisations rest and his scheme for the *Classification of the Elements* (this Journal, 1929, CXXXIX, 275, Nov. 1) has much to commend it, since it points out relationships and deviations to be expected among the chemical elements which few other arrangements have shown.

Again, he has attempted to achieve some kind of order from the chaotic state into which the system of organic symbols has fallen (*ibid.*, 1928, CXXXVI, 17) although, unfortunately, relatively little attention has been paid to his schemes.

Now there appears from his pen a monumental work in the form of a *Chemical Dictionary**.

This work is almost a key and supplement to both advanced textbooks and, in many ways also, to the old and new encyclopædias of pure and applied chemistry and allied sciences. Progress in every branch of chemistry has now become so rapid that even the most expert find difficulty in keeping pace with its development. Consequently, a more and more intensified specialisation has resulted, which reflects itself in a new and often ambiguous and fluctuating terminology. New ideas require new words and both are multiplying rapidly as the entire province of the physical and natural sciences which now extend from the gigantic universes down to the sub-atomic microcosmos, are being developed. Hence the need for a dictionary which records the old and new phenomena in the terms of our new concepts of matter and energy.

Prof. Hackh's *Dictionary* states clearly and precisely the theories, laws and rules of chemistry; it describes the elements, compounds, drugs, minerals, vegetable and animal products, it lists concisely the important reactions, experimental processes and methods, it mentions briefly chemical

* *A Chemical Dictionary.* By PROF. INGO W. D. HACKH. Pp. 790 with 232 illustrations. London: J. & A. Churchill, 40, Gloucester Place, W. 1930. Price 42s.

apparatus and equipment and includes also the collateral vocabulary of physics, astrophysics, geology, mineralogy, botany, medicine, and pharmacy, industry, mining and commerce in so far as these terms are pertinent to the field of chemistry.

The work contains a number of original charts and diagrams which should prove of great practical value. It is more than a word-book, it presents by means of numerous cross-references, encyclopedic paragraphs, etc., a cross-section of modern chemistry and brings widely scattered information into a compact, single volume.

For the chemist, it defines such recent terms as :

Activity, bathochrome, Budde effect, Compton effect, electronation, Hoffmeister series, ortho-hydrogen, screening effect, hypophamine, introfaction, irradiation, isostere, kernel, klydonograph, mass-energy cycle, metatenomery, miloiganite, motalin, Pauli's principle, Raman effect, Schrodinger atom, wave mechanics, Stoner quanta, syneresis, synthalin, etc.

For the student, it explains in simple language the fundamental concepts of :—

Acidity, atom and atomic structure, Bohr's theory, colloids, colour, crystallograms, electric units, element, hydrogen-ions, isomerism, oxidation-reduction, periodic-system, radiations, radicals, structure symbols, x-rays, etc.

Naturally, in a volume of this size—nearly 800 closely printed double-columned, large octavo pages—minor omissions have occurred and slight imperfections have crept in. These will doubtless be rectified in subsequent editions.

Prof. Hackh's invaluable inventory of the present day facts and terminology of chemistry and the allied sciences will be indispensable to chemists, analysts and others and should rapidly find its way into all reference libraries and on to many private book shelves.

J. G. F. Druce.

(In a second article, Dr. Druce deals critically with certain sections of the contents of Prof. Hackh's "Chemical Dictionary."

EXHIBITION OF PHYSICAL APPARATUS.

The twentieth annual exhibition of Electrical, Optical and Physical Apparatus, arranged by the Physical Society and the Optical Society, was held at the Imperial College of Science and Technology, South Kensington, during January 7, 8, and 9.

PUBLICATIONS RECEIVED.

The Institute of Physical and Chemical Research, Tokyo.

No. 207. The Angular Intensity Distribution of Continuous X-Ray Spectrum. By Y. Sugiura.

No. 209. The Development of Experimental Methods in Photo-Elasticity. By Z. Tuzi.

No. 211. Mechanical Properties of Snow-Layer. By M. Kuroda.

No. 212. A New Design of Cathode-Ray Oscillograph and its Application to Piezo-Electric Measurements. By S. Watanabe.

No. 213. Study of Impact Test by Means of Piezo-Electricity and Cathode-Ray Oscillograph. By S. Watanabe.

Australian Council for Scientific and Industrial Research.

Bulletin 43. The Bionomics of *Fasciola Hepatica* and of the Intermediate Host *Limnea Braziera* (Smith). By I. Clunies Ross, D.V.Sc., and A. C. McKay, B.V.Sc.

Annual Report of the Director of the U.S. Bureau of Standards, 1929. Price 10 cents.

American National Screw Thread Tables for Shop Use. (Bulletin No. 98). 10 cents.

FORTHCOMING CONGRESSES.

The central situation of Czechoslovakia makes it conveniently situated for European congresses and international meetings. Among the events to be held in Prague this year are :

The International Critics Conference.

Prague Spring and Autumn Fairs, Industrial and Sample.

International Congress for Hygiene.

International Conference of Criminologists.

A *Teachers' International Congress* will be held in Karlovy Vary (Carlsbad) in July and there will also be an Exhibition of Glassware at Zelezny Brod, and an Ethnographical Exhibition at Olomouc. At Bratislava there will be the usual " Danube Trade Fair " and at Liberec (Reichenberg) the *Textile Fairs*.

Forthcoming Events.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Friday, January 31, at 9 p.m.—Lord *Rayleigh*, Sc.D., F.R.S., M.R.I. : " Irridescent Colour in Nature."

ROYAL SOCIETY OF ARTS.

Monday, January 27, at 8 p.m.—(Cantor Lecture.) Harold J. L. Wright, of Messrs. P. and D. Colnaghi & Co. : " Three Master Etchers : Rembrandt, Meryon, Whistler." (Lecture II.)

Tuesday, January 28, at 4.30 p.m.—(Dominions and Colonies Meeting.) Sir Daniel Hall, K.C.B., D.Sc., LL.D., F.R.S. : " Settlers' Problems in Kenya."

Wednesday, January 29, at 8 p.m.—(Ordinary Meeting.) Sir Thomas H. Holland, K.C.S.I., K.C.I.E., D.Sc., LL.D., F.R.S., Principal and Vice-Chancellor of Edinburgh University : " International Movement of Mineral Products During Peace and War." (Trueman Wood Lecture.)

UNIVERSITY COLLEGE, LONDON.

Monday, January 27, at 2 p.m.—" Some Literature of the Great War." A public lecture by Mr. C. O. G. Douie, Secretary of the College.

Monday, January 27, at 5.30 p.m.—"The Philosophical Approach to Modern Social Problems." First of two public lectures by Professor John Macmurray, M.C. January 27 and February 10.

Wednesday, January 29, at 5.30 p.m.—" Recent County Library Developments." A public Lecture by Miss A. S. Cooke, Kent County Libraries.

Thursday, January 30, at 5.15 p.m.—" Momentous Law Suits and Trials in Various Countries from Classical to Modern Times." First of a Course of six public lectures (continued from the First Term) by Professor J. E. G. de Montmorency. January 30, February 6, 13, 20, 27 and March 6.

Thursday, January 30, at 5.30 p.m.—The Jevons Memorial Lectures : " The Relations between Ethics, Economics and Politics." First of a Course of four public lectures by Mr. A. D. Lindsay, M.A., Master of Balliol College, Oxford. January 30, February 6, 13 and 20.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

39,509.—I. G. Farbenindustrie Akt.-Ges. — Manufacture of double compounds of acridine series. December 24.

39,604.—I. G. Farbenindustrie Akt.-Ges. — Manufacture of double compounds of acridine series. December 27.

39,463.—I. G. Farbenindustrie Akt.-Ges. —Production of catalysts containing free acid of phosphorus. December 24.

Specifications Published.

322,998.—*Moulton, H. F., and Tschudin, E.*—Manufacture of nitrocellulose.

323,128.—I. G. Farbenindustrie Akt.-Ges. —Treating azo-dyestuffs.

304,245.—Soc. of Chemical Industry in Basle. — Manufacture of vat-dyestuffs.

Abstract Published.

321,425.—Nitrogen peroxide.—Johnson, J. Y., 47, Lincoln's Inn Fields, London. (I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Gases containing nitrogen peroxide in such proportion that cooling by water is sufficient to separate liquid nitrogen peroxide, are formed by oxidising gases rich in nitric oxide with nitric acid of 25.-68 per cent. strength at 40-110° C. The gases are passed up a packed tower down which nitric acid flows, and water is separated from the gases after treatment by condensation or other means. Dilute nitric acid from the base of the tower may be restored to its original concentration by absorption of nitrogen oxides. Gases containing nitric oxide suitable for treatment are obtained by acidifying nitrite solutions, by reducing with sulphur dioxide nitrate solutions such as the acid mother liquors from the manufacture of potassium nitrate, by decomposing nitrosyl chloride or by heating the solution obtained by absorbing nitric oxide in a solution of a ferrous salt.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His

MOPPON.

508,389.—Chemical substances used in manufactures, photography, or philosophical research, and anticorrosives.—George M. Callender & Co., Ltd., 25, Victoria Street, London, S.W.1. January 1.

MULTEX.

507,448.—*A chemical liquid for reducing the effects of sulphation in accumulators.*—Multi Services, Ltd., Burt Street, Cardiff. January 1st.

506,268.—A head-on view of an armoured knight on a war-horse, and a scroll bearing the words "EL CIO BRAND."—Cream of tartar, tartaric acid, tartrates and citric acid, all being chemical substances for use in manufactures. — Burton, Baker & Co., Ltd., 16, Eastcheap, London, E.C.3. January 1.

507,650.—Illustration of a crescent and the letters C and Co.—*Assay litharge.*—The Cookson Lead and Antimony Co., Ltd., Milburn House, Dean Street, Newcastle-upon-Tyne. January 1.

POETRY OF SCIENCE.

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Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

MATTER AND LOGIC.

By Dr. W. Tombrock.

Why No Force as Such?

Poincaré is said to have asserted that with a free choice of a geometric system we can explain every observed physical phenomenon with a physical "force."

In our article "*A Few Remarks*" (*Chem. News*, 1930, cxl, 23), it was pointed out that Einstein in his *generalised* theory of relativity has made gravitational "force" as such disappear. It now appears that Einstein in this work has so chosen his geometrical system—which thereby becomes more complicated than the ordinary Euclidian system—that gravitational force as such is by this means eliminated (see Prof. H. T. H. Piaggio: Einstein's and other unitary Field Theories: An Explanation for the General Reader, *Nature*, June 1, 1929, p. 841): "For example in this theory there is no need of a gravitational force to make a planet move in its orbit, for this orbit is as natural in his geometry as is a straight line in the geometry of Euclid and Newton."

This explanation of how gravitation is reduced to a simple description, "a simple account of physical phenomena," induces me to explain the disappearance of force as such *in our* system.

In this connection it is noteworthy that we have also, perhaps more than once, qualified gravitational force as a means of *describing* the gravitational phenomenon; it does *not* give us any explanation!

When Einstein thus succeeds in causing a factor in our speculations on nature, which has only a descriptive and not an explanatory value, to disappear by an alteration in the geometric system or alternatively in metamorphosing it into a geometrical factor, will he then by this means get any *further* than to an *altered description*, though it be a more accurate, more refined *description*, of natural occurrences? This does not seem to us probable. Does the *generalised* theory of relativity also give an *explanatory mechanism* by which gravitational effects are produced?

Why *we* assume no force as such is wrapt up in our intention and our starting point. We would have an *understandable* explanation of nature, thus we do not accept action at a distance, a force which acts without contact through an absolute vacuum between two material particles. Our object thus eliminates such a force; logic demands that an explanation should be understandable, otherwise it is no explanation.

Now our premises are: Matter is that which moves. Two material particles can*not* simultaneously occupy the same space.

Then matter *must* be discontinuous, consisting of particles, in an otherwise matterless vacuum, otherwise motion, and thus also matter, is impossible.

But a material particle, which is to be found in an immediate surrounding which is matter-free, and which has no *continuous* contact with another particle, can in this state *only* act on another particle by *action at a distance*. As we pointed out above, we eliminate this, however, on the basis of the principle of comprehensibility. We cannot thus include in our system any force "as such," acting between two particles in matter-free space so as to cause attraction or repulsion. For this reason thus no "true" gravitational force, which "as such" must act as to cause attraction between two particles, for this reason thus no "true" force actively directing motion. In so doing, provided we accept our premises of *motion and impenetrability of the ultimate* material particles, we must eliminate force "as such," on the basis of the principle of the *understandable* explanation.

An *explanatory mechanism* for the, actions, which one usually attributes to forces, is, however, really involved in our premises. We have a mechanism for the actions, the effects of which we attribute to the motions and collisions of the ultimate particles of matter, effects, if one would so express it, of the *resistance* forces, called into being by those collisions. This kind of force may be conceived as real or as imaginary, as being produced by contact and hence *are for us understandable.*

If finally we consider this question from another point of view, we may then say: the success of the *generalised* theory of *relativity makes it probable that gravitational* force is nothing more than purely descriptive, thus has no real explanatory significance; in other words it does *not* exist as such. One can then in the above mentioned success find a support for the correctness of *our* conception at the same time, that, namely, force "as such" does *not* exist. No theory can, moreover, do any damage to the empirical inductive reality of the motion and collision—our starting points—so long as one preserves the first place for empirical induction in exact science.

Finally I may assert that, as far as I am personally concerned, I was not aware when delineating my speculations that Einstein had eliminated gravitational force *qua talis*, even less that the conception of the *proton*

as a complex material unit in a cyclonic form of motion had been applied by others . . . I received opposition from the physical side against my conception of the ether as a gas with Democritian atoms! We will thus cut into this last question the first and in the first place just investigate what prominent chemists like Mendeléeff and Sir William Crookes thought about the ether.

Bergen op Zoom,
Holland.

THE LATE DR. SAMUEL RIDEAL.

The late Dr. Samuel Rideal, who died on November 13, 1929, whilst on a visit to South Africa in his 66th year, was a distinguished analytical chemist who had made many important contributions to the knowledge of the science. He published some twenty articles in *The Chemical News* between 1884 and his retirement. The January issue of *The Analyst*, in which he also published a number of important scientific papers, contains an appreciative notice of Dr. Rideal's achievements, from which the following is taken (pp. 2-3): "While still at University College, Rideal published, with A. G. Green, "A New Volumetric Method for the Estimation of Nitrous Acid," depending on the conversion of an acid solution of aniline into diazobenzene (*Chem. News*, 1884, XLIX, 173). This method has been of much service in analytical work. He also published "Delicacy of Some Tests for Antimony, Arsenic and Tin," in which two wires of different metals, twisted together, are placed in acid solutions of the salts (*Chem. News*, 1885, LI, 292).

While at St. George's Hospital Medical School he published "Organic Boron Compounds," in which the action of the chloride bromide and fluoride of boron on ammonia and on organic bases is dealt with (*Ber.*, 1889 XXII, 992). A little later he published, with S. G. Rosenbaum, "Estimation of Chromium in Chrome Ore and Ferrochromium, using Sodium Peroxide" (*J. Soc. Chem. Ind.*, 1896, XV, 155; *Chem. News*, 1896, LXXVII, 1). . . Dr. Rideal contributed the articles "Fermentation, Paraffin, Petroleum, and Tannin," to the new edition of *Watts's Dictionary of Chemistry*."

In his later work he carried out a large number of investigations upon water purification and other analytical matters. He took a prominent part in the affairs of the Society of Public Analysts and other Analytical Chemists, and was President in 1918-19. He was also an active Fellow of the Institute of Chemistry and other bodies.

LOW GRADE FUELS FOR STEAM GENERATION.

A Striking Example From The Rand.

By A Well-Known Engineer.

Modern developments in power plant equipment and chemical engineering generally have rendered the efficient utilisation of low grade fuels comparatively easy, an important matter in many industries.

A striking example concerns the use of high ash content coal at mines being the case of a well-known gold mining company on the Rand in South Africa. The boilers are of very small hand-fired "Babcock and Wilcox" water-tube type, without feed water economisers, each of 1,265 square feet heating surface, having a calculated evaporation of 3,850 lbs. of water per hour, based of course on good coal. One of these boilers was subsequently fitted with the "Turbine" forced draught steam jet furnace of standard design, 27.5 square feet actual effective grate area (5 feet 6 inches long) exposed to the air blast, and a detailed series of tests, under very accurate conditions have been carried out side by side with the above boiler and another having the ordinary hand firing.

In the case of the normal good quality coal used (Witbank) containing 20-25 per cent. ash, under ordinary conditions the coal burnt per boiler per hour was 500 lbs., and the water evaporated 1776 lbs., that is, 3.55 lbs. of water per lb. of coal, the general conditions also of the test being a steam pressure of 150-160 lbs., and very hot feet-water, about 200° F.

The corresponding boiler under exactly the same conditions equipped with "Turbine" furnace burns 760 lbs. of coal per boiler per hour, and evaporated 4,200 lbs. of water per hour, that is 2½ times the amount of steam, exceeding the calculated rating of the boiler, hardly ever attained in practice, and corresponding also to 5.60 lbs. of water per lb. of coal.

In a second series of tests much inferior coal was used (Springs), containing 33 per cent. ash. In this particular test the ordinary natural draught boiler with good class Witbank coal as before burnt 600 lbs. of coal per boiler per hour and evaporated 2,275 lbs. of water, that is, 3.70 lbs. of water per lb. of coal, a slightly better performance than the first one. Using "Springs" inferior coal the "Turbine" furnace boiler burnt 900 lbs. of coal per boiler per hour, and evaporated 3,275 lbs. of water, corresponding to 3.60 lbs. of water

per 1 lb. of coal. That is 50 per cent. more of the inferior coal was burnt with an evaporation of more than $1\frac{1}{2}$ times as much, naturally representing a very great economy because of the difference in price between the two coals.

ONTARIO MINING INDUSTRIES.

Ontario is producing more minerals to-day than the entire Dominion twenty years ago. The estimated value of production in 1929 is \$110,000,000, a total 10 per cent. higher than that of 1928. Ontario therefore produced more than one-third of the total production of minerals in the nine Provinces of Canada.

Real and substantial progress is evident from the Reports received from every branch of the mining industry, and important developments are pending in a number of areas where mines are being opened up, but from which production was not recorded during the past year.

Activity is particularly evident in the Sudbury district. The Porcupine gold field gives promise of a new lease of life, and the Kirkland Lake gold field is increasing its ore reserves in preparation for many years of production. The Cobalt silver mining area is experiencing a revival of interest in its older mines, whilst fresh discoveries are being made. In the new mining areas the Howey Gold Mines in the Red Lac district of north-western Ontario is on the eve of production; the Michipicoten gold area to the north-east of Lake Superior is undergoing active exploration and intensive development; Crow River and Pickle Lake, 25 miles north of Lake St. Joseph, are the scene of interesting developments following rich gold discoveries; in the Thunder Bay district, copper, gold and silver properties are being revived in the light of new knowledge, whereas at Boston Creek and in Munro Township, close to the Quebec Border, copper properties are coming under experimental production, ore being despatched to the neighbouring smelter at the Noranda Mine for treatment. Futhermore, diamond-drilling in the new lignite field on the James Bay slope has disclosed an immense body of useful fuel adjacent to the Abitibi River.

Expansion at Sudbury.

During the past year a new era has begun in the development of base metal mining in the Sudbury district, now one of the most flourishing metal mining centres in the world. The International Nickel Company of Canada, now controlling also the former Mond holdings, has during the year pushed forward important underground operations and has extended its smelting and refining plants. The two smelters at Copper Cliff and Coniston respectively have enlarged their operations, drawing ore from the Creighton, Garson, Levack and Frood Mines. The new four-compartment shaft sunk to a depth of over 3,000 feet came into operation at the Frood mine in January, 1929. During the first nine months there was an increase of more than 40 per cent. in ore mined and smelted, whilst the output of matte expanded by 48 per cent. New additions and extensions, including bins and concentrator, roasters, reverberatory furnaces and copper refinery are being rapidly constructed and on completion will enable the Company to double its pesent output. The fact that during the first nine months of 1929 exports of matte decreased from 28,745 tons to 17,553 tons shows that the major part of the refining is now being done in Canada at Port Colborne, Ontario. Exports of refined nickel and by-products have in the same period increased considerably.

New plants for the production of sulphuric acid and nitre cake respectively are now under construction by Canadian Industries, Ltd. (a subsidiary of the International Nickel Company, Ltd.), at Copper Cliff, and the older Mond sulphuric acid plant at Coninston has also been taken over by the same company. Research work is being actively pursued with a view to the further utilisation of the Sudbury smelter fumes.

At the Falconbridge mine, 15 miles north-east of Sudbury, a new nickel producer is approaching production. A shaft has already been sunk 1,000 feet, and preparations by Falconbridge Nickel Mines, Ltd., for mining ore are well advanced. The smelter building is completed and some of the equipment is in place, so that early in 1930 shipments of matte to this Company's refinery in Norway is probable.

Another development in the Sudbury district, about 17 miles west of the town of Chelmsford, is the new group of fines being brought into production by the Treadwell-Yukon Company. A lead-zinc-copper deposit is being developed systematically and at the concentrating mill 300 tons of ore can be handled daily with a production of about 140 tons of concentrates. A railway spur to the mine, six miles in length, was completed in October.

Increased Gold Production.

Gold production increased by over $1,000,000 during the first nine months of 1929, but the destruction by fire of the mill at the Dome Mine at the end of October must result in a decreased output there of over $300,000 monthly until arrangements are made for treating Dome ore either at the Hollinger Mine or at a new mill to be erected on the site of the old one. Nevertheless the growing output of other mines in the Province is expected to give Ontario an advance during the year of about 1 million dollars, production during the first three-quarters of 1929 having been the best on record. An interesting situation in the Porcupine and Kirkland Lake gold fields is shown by the following figures giving tonnages and values during the nine months :

	Porcupine	Kirkland Lake
Tonnage	2,186,889	816,573
Value	$14,247,891	$10,482,020

The Hollinger mine is milling nearly as much ore to-day as it handled five years ago, but there has been a decline in the grade. At Kirkland Lake, however, there has been an increase during the five years of 197 per cent. in tonnage milled, whilst the grade of ore has remained fairly constant. In the Porcupine field an interesting development to be recorded is the installation of a new gold-milling process at the McIntyre Miue, where a commercial unit having a daily capacity of 100 tons is being set up in order to prove laboratory successes. At the Hollinger mine a special geological examination is being made with a view to the discovery of new ore-bodies.

The gold mines in the Kirkland Lake field continue to advance in production and ore reserves are being accumulated at the leading mines. The Lake Shore mine is preparing to increase the tonnage milled, and it is anticipated that a total of 2,000 tons of ore will be milled daily when the additions to the plant are completed. The grade of ore is being well maintained as development proceeds and extraordinarily high values have recently been encountered in one section of the mine. At the Teck-Hughes mine the new shaft is now down 2,025 feet with 1,600 feet yet to go before reaching its present objective. The management contemplate the possibility of continuing operations down to 7,000 feet, and the new shaft is intended for development at these lower levels and for ventilation purposes. Production during the year is being continued at the rate of $450,000 a month and an increase of half a million dollars in the year's output is expected. At the Wright-Hargreaves mine much has been done during the past year in solving underground geological problems and the outlook for the future is brighter as the result. The same may be said of the Kirkland Lake Gold Mine, where development has penetrated to a depth of over 3,000 feet on the assumption that the Teck-Hughes ore zone extends into this property at the lower level. Production at the Sylvanite mine at the rate of about $700,000 per annum places this property in the fourth position in the Kirkland Lake group.

Prospective Gold Producers.

The outstanding development among the prospective gold mines is the installation of a 500-ton mill at the Howey Mine in the Red Lake area, which will probably be brought into production early this year. At the St. Anthony Mine at Sturgeon Lake in the Thunder Bay district, as well as at the Cooper Mine in the Michipicoten district, milling operations on a small scale were started last year. The Telluride Mine in Skead Township in the Boston Creek area has a mill under construction, while the Moss Mines Company has decided to erect a mill on its property to the west of Port Arthur. Prospects of a new gold area at Pickle Lake and Crow River, in the district north of the Albany River, including the Central Patricia and Northern Aerial Minerals Exploration properties, appear to be good, a considerable amount of diamond-drilling having been done. A shaft is being sunk to a depth of 500 feet on the Central Patricia property.

Silver Mining.

Notwithstanding the decline in the market price of silver, output of this metal during the past year advanced by about 21 per cent. in quantity and 14 per cent. in value largely owing to the active demand for cobalt, which metal is associated with silver in the ores of the Cobalt area. Fonr mines are in operation at Cobalt where also many of the older properties are being worked under lease on a partnership basis: These latter operations accounted for the production during the first nine months of the year of over a quarter of a million ounces of silver. An encouraging feature of mining operations at Cobalt is the continued success of the development at the O'Brien Mine on the Cross Laek property.

At Gowganda the Miller Lake—O'Brien and Castle-Trethewey mines—with which Capitol Mines is now united, produced more than one million ounces during the first nine

months. An interesting development is reported from the Morrison Mine where, after extending the shaft to a depth of 400 feet, high-grade silver ore was encountered in the diabase while drifting. In the South Lorrain area, the Keeley, Lorrain Trout Lake and Frontier-Lorrain Mines were responsible for more than half a million ounces during the same period.

NON-METALLIC MINERALS.

Production of non-metallic minerals seems likely to have been well maintained during the year, increases having been reported in graphite, feldspar, gypsum, mineral waters, petroleum, quartz and salt. Next to natural gas and salt, gypsum is the most valuable non-metallic mineral produced in Ontario, extensive deposits being found in the south and extreme northern areas of the Province. Those in the south have been under development for many years, but the immense deposits in the Moose River area on the James Bay slope have not yet been fully explored.

LIGNITE DEPOSITS UNDER DEVELOPMENT.

On the James Bay slope in the vicinity of the Abitibi River an extensive body of lignite has been known for many years. Nothing, however, was certain as to the size of the deposit until the extension northward of the Temiskaming and Northern Ontario Railway enabled the Provincial Department of Mines to institute a systematic examination by diamond-drill. Drilling has already indicated a body of lignite two or three square miles in extent, lying 60 feet below the surface and having an average thickness of about 20 feet. Drilling up to date has been on the eastern side of the Onakwana River, a parallel tributary to the Abitibi. Further drilling is in progress on the western side of the Onakwana, but so far there has been no indication that the limits of the deposit have been approached. Study is being made of the over-burden with a view to a decision as to the best method of mining. The Cretaceous basin in which the lignite occurs is the smallest of three such basins on the James Bay slope in which lignite out-croppings have been found.

GEOLOGICAL EXPLORATION.

During the past year the Ontario Government sent out ten field parties to make geological surveys and one to survey the clay industries. Special attention was directed to the Pickle Lake and Crow River areas north of Lake St. Joseph, much interest being displayed at the present time on the geological character of this part of the Patricia district. The mineralisation of these areas occurs along fracture zones intersecting a belt of ancient greenstones and related rocks lying within an area of granite. A chromite deposit of economic importance has been located at Obonga Lake, situated about 20 miles by canoe south of Armstrong on the Canadian National Railway and accessible also by way of Lake Nipigon and the Kopka River. A body of peridodite of eliptical shape in surface outline has a major axis of three and one-half miles and a minor axis of three-quarters of a mile. The peridodite has been largely altered to serpentine. Disseminated deposits of chromium ranging from 8 to 17 per cent .of Cr_2O_3, occasionally rising to 27 per cent., occur over a foot wall contact 2,000 feet in length, and a series of massive chromite veins has been found at some distance from the contact. These veins average 34 per cent. of Cr_2O_3. Exploration of the deposit is proceeding by diamond drilling and otherwise, and the results will be awaitet with interest, as the world's supplies of this useful metal are limited.

OUTLOOK FOR 1930.

The Ontario mining industry faces the New Year with an optimistic outlook. Production has largely increased during the past twelve months. New fields are under active development, and prospecting in virgin areas has been quickened and intensified by the use of the aeroplane and motor canoe.

BRITISH INDUSTRIES FAIR, 1930.

The British Industries Fair is perhaps the one Exhibition above all others which offers the greatest opportunity of seeing the latest developments in British manufactures gathered together under one roof. This will be even more true in 1930, when the Fair moves to its new home at Olympia, as the various sections will not be separated to the same extent as at the White City.

CHEMICAL SECTION.

The Chemical Section this year will be housed on the ground floor in the Main Hall Annexe at Olympia, close to the Druggist's Sundries Section, and will include the usual wide range of products.

Some 10,000 square feet are occupied by this Section.

The arrangements for the Chemical Section are under the auspices of the Association of British Chemical Manufacturers, 166, Piccadilly, W.1., who will have an office on Stand No. B.75, to deal with any enquiries

in regard to chemicals, and which will also be available for information concerning insecticides. It should be noted that the Association's Directory, which will be available to bona fide purchasers, is an ambitious publication in six different languages, and is therefore of a particular value at a Fair of this kind, to which buyers come from all over the world. There will be no collective exhibit of chemical plant, but the British Chemical Plant Manufacturers' Association will have an office on Stand No. B.74, which will distribute the official Directory of the Association and answer enquiries on plant for the chemical and allied industries. Appointments can be made at the office and the catalogues and trade literature of individual members will be available.

MESSRS. ALBRIGHT & WILSON, LTD.
Stand Nos. B.90 and B.95.

Phosphorus and its compounds immediately suggests the name of Albright & Wilson, Ltd., of Oldbury, Birmingham. This firm enjoys a world-wide reputation for the manufacture of fine chemicals, and in addition to phosphorus and its many derivatives, including technical and pure phosphoric acid, sodium and calcium phosphates, glycerophosphates and hypophosphites, they will exhibit special preparations of a very high standard of purity such as carbon tetrachloride (technical and medicinal), ammonium persulphate, pure precipitated sulphur, and the well-known aerating materials "Antelope" and "Ibex."

Their special display of Silicon Ester will be of general interest. In addition to exhibits illustrating its use as a paint medium for decorative work on concrete, asbestos cement sheet, and other line-containing surfaces where oil paints are inapplicable, an attractive display has been arranged in conjunction with Messrs. Raines & Porter to demonstrate its employment in the preservation and restoration of stone and brickwork.

MESSRS. THE ALUMINIUM PLANT & VESSEL COMPANY, LTD.
Stand No. B.101.

The Aluminium Plant and Vessel Company, Limited, are exhibiting a wide range of Chemical Plant consisting of welded sheet metal, and of cast alloys which are suitable in a very limited number of cases.

The Company is showing a special Varnish Cooking Plant which is suitable for the manufacture of Stand Oils and is the latest departure in the manufacture of these and kindred thickened oils.

The Company has been devoting considerable attention to the welding of copper and of nickel. A highly satisfactory weld has been obtained in both these metals with obvious advantages from the chemical point of view. Examples of plant made by these welding processes will be shown.

The exhibit will consist of the following items—

(1) Special Oil Cooking Plant, combined with the "A.P.V." Heat Exchanger for heating and cooling liquids.

(2) An aluminium steam-jacketed pan of welded construction.

(4) An aluminium cellulose mixing vessel.

(5) A cellulose and spirit varnish churn.

(6) An aluminium bogie.

(7) An aluminium varnish pot with special bronze bottom.

(8) Piece of welded copper apparatus.

(9) Stainless steel apparatus.

(10) Aluminium, a selection of trays and small utensils.

(11) Cast aluminium apparatus.

(12) A piece of special aluminium alloy apparatus.

The "A.P.V." Heat Exchanger is a plate heat exchanger so arranged that when ready for work a series of channelled plates are held in close proximity to each other, forming a series of tubes. When the machine is opened the plates fall apart and are accessible for cleaning without any of the difficulty which is experienced in a tubular cooler.

The machine is highly efficient thermally, very compact, occupying only a portion of the space of a tubular heat exchanger. It can be increased in capacity by the addition of extra plates.

MESSRS. A. BOAKE ROBERTS & CO., LTD.
Stand Nos. B.91 and B.94.

This well-known firm have endeavoured to arrange that on their Stand at the 1930 Fair the full range of their fine and technical chemicals is represented. This means that there will be over 700 separate specimens on the Stand. As usual members of their technical and scientific staff will be available on the Stand so that buyers may rely on obtaining specialised information regarding any of their numerous types of product.

Among their essential oils, of which there will be a very full display, will be found some interesting essential oils and certain intermediates of prime importance. There will be a complete range of the various fine chemicals in which the firm has specialised.

The firm will also show a display of perfumes and perfume bases for use in scents,

soap, bath salts, creams, brilliantines, disinfectant sprays, etc., *together with materials* for covering the odours of oils and fats.

Amongst their technical chemicals will be found liquid sulphur dioxide in glass syphons, tins and iron cylinders, and there will also be specimens of sulphites, bisulphites, and metabisulphites, together with phosphates, saponines, sulphonated oils.

There will be a further section devoted to solvents, plasticisers, gums and resins, which will contain a full range of products required in the preparation of cellulose lacquers. *Paint manufacturers* will be interested in the specimens of metallic oleates, stearates, linoleates, tungates, palmitates, and resinates.

Chemicals used for food products are represented by a range of flavouring essences, food colours, and preservatives suitable for mineral waters, confectionery, baking, table jellies, ice creams, tobacco, snuff, jams, and sauces. These are guaranteed to conform to the Sale of Food and Drugs Act, Public Health (Preservatives, etc., in Food) Regulations, 1925, and all others in force in this country.

One of the most interesting sections will be a special display of some 30 fine chemicals, which are now shown for the first time. Many of these are likely to arouse considerable interest, and news of their manufacture in this country will be very welcome to users who up to the present have had to rely on foreign sources for their supplies.

MESSRS. THE BRITISH CYANIDES CO., LTD.

Stand Nos. B.50 and B.55.

The British Cyanides Co., Ltd., of 49, Wellington Street Strand, W.C.2., in conjunction with the Beetle Products Co., Ltd., of Pope's Lane, Oldbury, Worcester, will be showing their synthetic resins and white and coloured moulding powders.

There will be a repetition of the successful demonstrative moulding plant in operation, on which buyers and the public will be able to see articles actually moulded from beetle moulding powders.

Beetle Sales, Ltd., will display a very wide range of moulded articles in attractive colours and mottled effects, as produced by the *various firms using* Beetle moulding powders. They will include cups and saucers, tumblers, decorative bowls, thermos flasks, lamp shades and stands, cigarette boxes, soap bowls, toilet articles and a range of household fittings and door furniture.

GENERAL NOTES.

STOKER EQUIPMENT FOR BATTERSEA POWER STATION.

In view of the prominence which the dail Press has recently given to the subject c smokeless combustion—referring more pai ticularly to the proposed Battersea statio —it is interesting to note that the Engineer of the London Power Company, having con *sidered all types of combustion equipment* have placed an order direct with the Taylo Stoker Company, Ltd., of Bush House Aldwych, London, W.C., for the complet fuel burning equipment for the first sectio *of this station to be constructed.* Thi equipment comprises six Taylor multipl retort underfeed stokers each twent retorts wide and forty-nine tuyeres long These stokers will be equipped with rotar *ash discharge mechanism* which consists o a deep pocket at the rear of the stoke proper, at the bottom of which are tw large slowly revolving crusher rolls. Pre heated air of 330° F. will be used. Th *stokers will fire six boilers and* each uni will be capable of producing 350,000 lbs. o steam per hour continuously at 600 lbs pressure. Any pair of these units wil supply sufficient steam for one 65,000 k.w turbine at full load.

The new "Kraftwerk-West" of the Berlin Electric Co., is to be supplied with eight equipmeuts of similar design and steam output.

STREET LIGHTING AND OTHER ROAD PROBLEMS.

"During the past ten years millions of pounds contributed by taxpayers and ratepayers *have been spent on our highways*," said an experienced road constructional engineer recently. "As yet, however, nc universal specificatious have been laid down, so that, in some instances, a single stretch of road may be in the hands of as many as a dozen different authorities. During the next few months, commitments for large sums will be voted by hundreds of local authorities for road construction and repair work. The present time is, therefore, opportune for at least a measure of unification between various districts.

"If a central authority were established, it would be able to collect information—at present only available locally—for the benefit of all surveyors, engineers and contractors. Such an authority would then be in a

position to see that highways connecting large cities were made of standard material with uniform width, camber, kerbs, etc., most suited to the type of vehicle likely to use them.

"With the heavy toll of accidents, the problem of lighting arterial roads is becoming increasingly serious. In many areas important national highways are in complete darkness. In other districts, the glare of naked bulbs merely helps to dazzle the night motorist. The most suitable form of illumination, according to the various public lighting associations, are lamps which shed a steady and soft diffused light over a wide area. Experiments which seem to bear out this statement are now being carried out in South London.

Proceedings and Notices of Societies

THE PHYSICAL SOCIETY.

The last meeting was held on Friday, January 24, 1930, at the Imperial College of Science, Imperial Institute Road, South Kensington, S.W.7. The following papers were read :—

A Method of Examining Stereoscopic Photographs. By J. M. Nuttall and E. J. Williams.

The paper describes a method of analysing stereoscopic photographs which has been found snitable for the examination of Wilson cloud tracks. The method consists essentially in replacing the photographic places in the cameras, illuminating them and tracing out the common image which coincides in space with the object originally photo graphed. A system of movable pin points is used to trace out the contour of the image, the adjustments of the cameras being kept exactly the same as when the photographs were taken. The chief advantage of the method is its simplicity—practically no computation is required and it is not necessary to know the stereoscopic angle, the magnification, etc. The method has been used by the anthors to measure the ranges of secondary β rays and in investigations on the initial directions of emission of photoelectrons, and it has been found convenient and accurate.

...*The Photography of Fabry and Perot Interferometer Fringes by the Use of a Simple Optical System.* By S. E. Green, B.Sc., Imperial College of Science.

A simple method of photographing Fabry and Perot interferometer fringes is outlined, and some examples of the results obtained for mercury radiation are given.

Characteristics of Discharge Tubes under "Flashing" Conditions, as Determined by the Use of a Cathode Ray Oscillograph. By Miss A. W. Leyshon, Ph.D.

An account is given of a method of determining the current-voltage characteristics of discharge tubes under "flashing" conditions, a cathode ray oscillograph being used. Results are given for neon lamps of the commercial Osglim type. Current time and voltage time curves are derived from the oscillograph records.

It is suggested that the method might prove useful in investigations on intermittent discharges in various gases under different conditions of pressure and disposition of the electrodes.

A demonstration of a pH apparatus was given by W. E. Doran, M.A., The Cambridge Instrument Co., Ltd.

A New Periodic Effect in a Neon Discharge Tube. . Demonstration given on December 13, by Dr. W. A. Leyshon.

Observations were made recently with a cathode-ray oscillograph on the shape of the discharge-current/time curves in a number of beehive Osglim lamps arranged in turn in a "flashing" circuit. It was noticed that in the case of two lamps having cathodes consisting of more open spirals than the others, the times taken to reach the maximum current in the discharge were greater. It was suggested to me by Dr. W. H. Eccles, F.R.S., that the discharge might "creep" up the cathode, and that it might be possible to observe the movement by a specially devised stroboscopic method. It shonld be remarked that the order of time concerned in the rise of the discharge to a maximum value was 10^{-6} seconds.

I thought that the effect might be accentuated, and therefore might be easier to detect, if the cathode were very much larger than the anode, and if the latter were placed as asymmetrically as possible with respect to the former. The two I-type lamps shown were made up for me in the research laboratories of the General Electric Company; in each the anode is about 4 mm. long and is placed opposite the lower end of the cathode which is of the dimensions usual in this type of lamp. The lamps were filled with pure neon at a pressure of 14 mm. of mercury.

On attempting to obtain the static volt/ampere characteristics of these lamps in the usual way, I found that for certain values of voltage and current small periodic fluctuaations occurred, the cathode glow and the anode glow undergoing changes in position simultaneously with the fluctuations. When

the two glows were nearest to each other the current was greater and the voltage less than when they were more separated. The actual changes in current were in general a small fraction of the total current passing through the tube, and they took place quite suddenly.

The movement of the glows could be followed by eye, the periodic time being of the order of ½ min. in most cases. In one type of oscillation it was noticed that the tope of the cathode glow crept up the electrode and, when it just reached the top, the whole glow contracted suddenly to the top of the cathode, the anode glow moving to the far side. The change in current occurred at the instant of contraction. The glow now stayed at the top of the cathode for some time, very gradually creeping downwards, and then suddenly dropped, the current suddenly rising. Sometimes the movement was in two stages, the glow waiting for some seconds half way up the cathode before going on its upward or downward way. The current here had an intermediate value. Other types of movement were noticed with different values of current through the lamp.

The phenomenon was observed originally with a high variable resistance, of the order of 100,000 ohms, in series with the neon tube. When this resistance was slightly reduced the periodic time of the fluctuations was diminished. A similar effect was obtained by increase of the applied potential. Later, a saturated diode (triode with grid and anode connected) was connected in series to control the curreut. This arrangement was found very convenient. In one experiment, heating the tube slowed up and finally stopped the oscillations; cooling it by resting it on a block of ice increased the frequeucy. One tube gave rapid flickers with comparatively large fluctuations in current when near the extinction point. It was found that a transverse magnetic field in one direction (such that an electron current would be urged upwards) increased the frequency; in the opposite direction it reduced the frequency. The anode glow moved rapidly from one part of the anode to the other, changing in appearange as it went.

For certain circuit conditions a note was heard in telephones included in the circuit, generally when no periodic movements of the glow were being observed. In one case the note gradually fell in frequency, and when it could no longer be heard the glow suddenly contracted. The glow then gradually spread out again jumped upwards, and the process was repeated. The phenomenon may well be associated with the production of ionic oscillations. The observed movements of the glows and the changes in current indicate that the periodic occurrences observed are some form of relaxed oscillation.

It is hoped to examine the phenomenon in more detail in the future.

A Method of Showing the Phase Relation Between the Flash and the Fork in a Fork-Controlled Flashing Neon-Tube Circuit. Demonstration given on December 13, by Dr. W. A. Leyshon and Miss Teresa M. Dillon.

The fork-controlled flashing neon-tube circnit was first described by Dr. W. H. Eccles and one of us (W. A. L.). Later, a theoretical and experimental investigation of the controlling action was made, a cathode-ray oscillograph being used. It was shown that the fork would attain its maximum amplitude when its effect on the period of flashing was greatest, the period being shortened by the reaction of the fork. Further, in this condition the flash occurred when the fork was in a position of maximum displacement away from the attracting coils. It was also shown that if the circuit conditions were altered within a suitable range so that the frequency of flashing without control would be rather greater, the fork could still be maintained, with diminution of amplitude and alteration of phase.

In the present apparatus light from the neon limp is received on the objective of a microscope. Part of the field is obscured by one prong of the tuning fork, which in this apparatus has a frequency of 100 cycles. The microscope is focussed on the upper surface of the prong, and when the fork is being steadily maintained by the flashing circuit the dark edge appears to be quite steady. Its position alters laterally with any change in the phase relationship. Light from a small lamp is focussed on the edge of the fork, so that a number of bright spots of light can be seen when the fork is stationary. These are seen as bright lines when the fork is vibrating, their length giving the amplitude of the vibration. The position of the dark edge with respect to these bright lines is an indication of the phase. When the fork is vibrating with maximum amplitude it is seen that the dark edge is at the end of the bright lines corresponding to the position of the fork furthest from the coils.

THE OPTICAL SOCIETY.

A meeting was held at the Imperial College of Science and Technology, South Kensington, on Thursday, January 16, Mr. J. Guild, Vice-President, in the chair.

Mr. Conrad Beck and Mr. R. W. Cheshire were elected Hon. Auditors.

The following papers were presented :—

The Ross Modification of the Hilger Interferometers for Testing Large Optical Elements. By O. G. Hay, A.R.C.Sc., Member of the Technical Staff of Ross, Ltd.

The instrument is a modification of the Hilger lens and prism interferometer and is intended for use in testing and figuring large optical elements such as astronomical telescope objectives, coelostat mirrors, etc., where the free aperture of the test element is larger than the normal aperture of the interferometer. A detailed description and drawings of the apparatus for testing optical systems of about 12″ diameter is given and the importance of geometrical design of the various parts is emphasised. It is intended to construct the proposed interferometer for the purpose of ascertaining the possibilities and limitations of the method and then, with the experience derived from this instrument, to apply the method on a more ambitious scale.

The Reflection Factor of Magnesium Oxide. By J. S. Preston, B.A., A.Inst.P., of the National Physical Laboratory.

The reflection factor of smoked surfaces of magnesium oxide is measured by means of a small hollow sphere having three openings; one for admitting light another for observation of the inside of the sphere by means of a photometer and the third to be covered by a standard plate or by the specimen surface to be tested.

Apparent factor for—

Total factor under diffused light			-0.974
90° incidence	... +45°	view	-1.00₅
45° ,,	... +90°	,,	-1.00₅
Diffuse ,,	... +45°	,,	-1.00
,, ,,	... +90°	,,	-0.98

The following Demonstrations were given :

A Visual Test with a New System of Equi-Photic Illumination. By J. N. Morris, B.Sc., of Messrs. Raphael's Ltd.

The apparatus is of the drum type illuminated by strip lights contained within a lamp tube, of length approximately equal to that of the Snellen Chart on each face of the drum, placed at about twelve inches in front and a short distance to the sides of the chart. This gives perfect illumination in the vertical meridian. Uniformity in the horizontal meridian is secured by making the horizontal section of the drum slightly concave.

Scientype Occluding Glasses for Use in the Treatment of Squint. Described by Mr J. Cole, of Messrs. Raphael's Ltd.

One of the spectacle glasses has one surface regularly patterned with depressions so arranged that the vision of the corresponding eye is reduced whilst the external appearance of the eye is unaltered. In order to force the deviating eye to make effort to see it is necessary to reduce the vision of the fixing eye below that of the deviating eye.

GEOLOGICAL SOCIETY OF LONDON.

January 8, 1930.

Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the chair.

The following communications were read :

Some Valentian Corals from Shropshire and Montgomeryshire; with a Note on a New Stromatoporoid. By Stanley Smith, M.A., D.Sc., F.G.S.

The paper describes some Valentian corals recently collected in Shropshire and Montgomeryshire, which include a number of new forms. Hitherto, little systematic work has been done on the British pre-Salopian corals, although various species have been described from these rocks by Lonsdale, Phillips, and McCoy, and by later authors; many of these, however, were unfortunately founded on casts. The most important contribution made to our knowledge of the coral fauna of the Caradocian and Valentian of Britain was furnished by Nicholson and Etheridge in their 'Silurian Fossils of Girvan' (1878). The present work conclusively shows that the Valentian coral fauna is not primitive, and that it is more closely allied to Salopian than to Caradocian assemblages; nevertheless, the important place occupied by the species of *Streptelasma* in the *Pentamerus* Beds links these up with the Ordovician. The Purple Shales, on the other hand, have yielded several species of Rugose corals which are typically Salopian. The Tabulate corals are of little interest, except in so far that they prove the very long range of the Lower Palæozoic species; there seems to be little, if any, difference between the Caradocian, the Valentian, and the Salopian forms.

The paper concludes with a brief note on a Stromatoporoid which belongs to the genus *Clathrodictyon*, and is common in the *Calostylis* Limestone—a bed remarkable on account of its lithological character, no less than for its rich coral contents.

The Carboniferous Inliers at Codrington and Wick (Gloucestershire). By STANLEY SMITH, M.A., D.Sc., F.G.S.

The Author describes several inliers of Carboniferous rocks situated on the eastern side of the Bristol Coalfield, south of Chipping Sodbury, where, except for these outcrops, the margin of the basin is concealed by Mesozoic strata. The largest, and in every way the most interesting, of these is the Wick Rocks Inlier, which lies on the same line of latitude as the Avon Gorge—some 9 miles away to the west.

The several outcrops expose, although not quite completely, a succession of beds ranging from the Tournaisian (Z_2) to Coal Measures.

The arenaceous beds which succeed the limestone sequence are better exposed in the Wick Inlier than anywhere else in the Bristol district. These belong in part to the Lower Carboniferous, in part to the Upper, and within the series (formerly mapped as 'Millstone Grit') a considerable break in the Carboniferous succession must occur, for, while the lower beds include some thin gritty limestones which contain Visean fossils, the highest yield plant-remains characteristic of the Yorkian stage.

The arenaceous phase set in early in D_2 time, but calcareous conditions returned for a period before it finally established itself.

The paper, by concentrating upon the higher (arenaceous) sequence, and dealing in less detail with the lower (calcareous) development, supplements rather than amplifies the work of the late Arthur Vaughan.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Formation of Film of Cupric Oxide in Alkali Solution. By YOGORO KATO AND NAGAO HAYAMI.

Essential Oil of Nothosmyrnium japonicum. III. Separation of Nothosmyrnol and 2, 4-Dimethoxy-allylbenzene; Derivatives of Nothosmyrnol. By TAKEYU TAKAHASHI.

Constitution of Wogonin. By SHIZUO HATTORI.

Anhydrosugars. I. Constitution of Anhydrosugars. By CHOJI TANAKA.

Anhydrosugars. II. Action of Superheated Steam on Anhydrosugars. By CHOJI TANAKA.

Milk. I. Mineral Constituents of Cow's Milk. By KINSUKE KONDO AND SHIGEKI MORI.

Sinomenine and Disinomenine. XIV. Bromosinomeninone. By KAKUJI GOTO AND TARO NAMBO.

CORRESPONDENCE.

KRYSTLMOTS.

(*To the Editor of* THE CHEMICAL NEWS.)

Sir,—With practically no knowledge of chemistry as ordinarily understood, the writer has pursued a line of investigation with some measure of success, and wishes to go further in obtaining crystallizations of beautiful form on micro-slides to provide "motives" for design work.

Continually experimenting, I have tried out most substances readily obtainable. Only a proportion of them give worth-while results, and I am desirous of obtaining other substances not ordinarily obtainable from dealers. Plant alkaloids, glucosides, etc., *i.e.*, organic compounds, have been found most useful.

Only quite small quantities, and no very expensive items are wanted, a gram is sufficient for my experimental purposes. The compounds need not necessarily be pure; "intermediates" in other experimental work might possibly be useful.

The essentials are that the substances must be of a crystalline nature, with m.p. not above 250° C., and preferably below 200°, or if they are easily soluble in alcohol, water or ether.

Would any manufacturer or worker be willing to assist?

I should also be glad to know of any really good work listing all such substances and giving the required information as to m.p., solubilities, etc. I have a Condensed Chemical Dictionary, and several manufacturers' lists, but a big percentage of items in the latter are not in the Dictionary, and for all I can tell to the contrary, they may be liquids. On the other hand, the Dictionary lists a great variety of substances which would seem to suit my purpose, but which I cannot find in manufacturers' lists.

If any of your readers can help me to get into touch with sources of supply and information, I shall be very grateful.

Yours faithfully,

FRED G. WOOD.

Marsden,
Ashtead, Surrey.

SIXTH INTERNATIONAL CONGRESS OF MINING, METALLURGY AND APPLIED GEOLOGY.

LIEGE, JUNE, 1930.

(*To the Editor of* THE CHEMICAL NEWS.)

Sir,—In a circular letter addressed in May, 1929, to the scientific and technical Institutions, it was announced that a Committee had been formed under the auspices of the Association des Ingénieurs sortis de

l'Ecole de Liége and of the Société Géologique de Belgique at Liége, for the purpose of organising in 1930 an International Congress of Mining, Metallurgy and Applied Geology.

The Committee is gratified to be able to annouuce that His Majesty King Albert has condescended to extend His Exalted Patronage to the Sixth Congress and that the Congress will take place under the patronage of the Belgian Government. The meetings will take place at Liége from Sunday, June 22, to Saturday, June 28, 1930. Arrangements have been made concerning :

1. The constitution of the Honorary Committee and of the General Committee of Organisation.

2. The rules of the Congress.

3. The list of subjects proposed for discussion at the meetings.

4. The summary programme of excursions and visits to works.

It should be noted that the list of questions proposed for discussion is not restricted. The Committee is prepared to consider any suggestions which may be offered to them and to accept other subjects, which will be notified in a future circular. The Committee is prepared to receive offers of papers and reports on one or other of the proposed subjects, or upon any other question arisiug out of the programme, and to add these to the list.

At the conclusion of the meetings, visits will be made to the exhibits displayed in the Exhibition aud especially to those referring to Mining, Metallurgy and Applied Geology.

All individuals, societies, institutions aud corporate bodies who are interested in mining, metallurgy or applied geology are entitled to become members of the Congress and will be registered in two classes, namely,

Patrons, who pay a fee of at least £5 10s.

Members, who pay a fee of £1 for one Section, and 7s. for each additional Section of the Congress in which they may wish to register.

All communications to be addressed to the General Secretary of the Sixth International Congress of Mining, Metallurgy and Applied Geology, 16, Quai des Etats-Unis, Liége, Belgium.

On behalf of the Committee of Organisation,

P. FOURMARIER, *President.*
Member of the Royal Academy of Belgium, Chief Engineer of Mines, Professor of the University of Liége.

O. LEPERSONNE, *General Secretary.*

PROF. HACKH'S DICTIONARY OF CHEMISTRY.

II.

Modern chemical literature is so extensive that even the most prolific scientific reader cannot hope to do more than glance through a mere fraction of the publications dealing with this science. The majority of scientists may read their favourite one or two periodicals but they rely upon the abstracting journals to keep them informed of the recent developments and discoveries.

Prof. Hackh, in the preface of his *Chemical Dictionary*, mentions that he has drawn upon these, particularly the American *Chemical Abstracts*, the terminology of which has been taken as standard, although the author has had the assistance of Dr. J. Grant, F.I.C., of London, who has thus been able to ensure the inclusion of terms and definitions reflecting British usage. Thus the *Chemical Dictionary* assumes a truly international character. The pronunciation followed, a key to which appears at the foot of each page, has evidently been the subject of much thought and that adopted generally accords with the usual English practice. The introductory part of the work also includes tables of Prefixes and Suffixes used in chemistry and also a scheme of abbreviated symbols used currently in Organic chemistry.

The usual order of presenting or describing a body is Name (pronounciation) formula, mol. weight, synouyms, occurrence, preparation or type, appearance and characteristics, and uses. Cross references are freely given, but references to the literature have generally been omitted. A few typical examples may be given. The following appear together on page 214 :—

CRYSTALLOGRAPHIC APPARATUS (*kris-tal-o-graf'-ik*). A device for measuring the angles and optical properties of crystals; as, goniometer, dichroscope, petrographical microscope.

CRYSTALLOGRAPHY (*kris-tal-og'-raf-e*). The science of crystals. Originally the measurement and classification of the external shape of crystals (crystal systems); now, the study of the internal, molecular and atomic arrangement of crystals (crystal structure).

* *A Chemical Dictionary.* By PROF. INGO W. D. HACKH. Pp. 790 with 232 illustrations. London : J. & A. Churchill, 40, Gloucester Place, W. 1930. Price 42s.

CRYSTALLOID (*kris'-tal-oid*). An obsolete term applied to non-colloidal substances, hence, those substances which pass through a semi-permeable membrane. The broader meaning of "colloid" has eliminated this distinction.

CRYSTALLON (*kris'-tal-on*). Seed crystal. A center or nucleus at which crystallization starts.

CRYSTALLOSE (*kris'-tal-ōs*). A soluble sodium salt of saccharin which is used in diabetes as a sweetening agent.

CRYSTULE (*kris'-tul*). A unit cell of a crystal or a crystal unit.

CUBE (*kub*). A regular solid bounded by six, equal square plane faces, the opposite faces being parallel. Cf.: space lattice. HYDROGEN – An alloy of 35% sodium and 65% lead pressed into cubes, and used for the rapid preparation of hydrogen (hydrone). OXYGEN – Cubes of sodium peroxide with a trace of cupric oxide; used for the rapid preparation of oxygen (ozone).

CUBEB (*ku'-beb*). The dried unripe fruit of *Piper cubeba*, a Piperaceae of Java. The fluid extract is a stimulant and diuretic. c, CAMPHOR $C_{15}H_{26}O=222.22$. The solid portion of oil of cubeb. c OIL. An essential oil of cubeb ;it is an aromatic, colourless liquid whose constituents are cubebene and cubeb camphor.

There are many unusual entries, including a large number of elements whose discovery has been claimed but which have not been ferified or accepted. These include norium, vestium, dubhium, etc., *i.e.*, mostly from the first half of last century.

On page 374, *hypon* is described as a hypothetical noble gas with atomic number 118 which is assumed to be the radioactive source of stellar energy. On page 740 the term *transuranium* is used for elements, so far undiscovered, of atomic weights higher than that of uranium. It is calculated that 98 per cent. of the universe consists of these elements and that the known elements of our earth and those found by spectrum analysis constitute only 2 per cent. They are supposed to exist in the interior of stars.

Other features of this encyclopædic *Dictionary* are the large number of illustrations and photographs and the "two-line" biographies. Critics, no doubt, will point to minor omissions and to typographic and other errors. The present reviewer has observed remarkably few actual mistakes, and these are of no significance. This is of importance since an error once in print, especially in a work of reference of this kind, is apt to be copied and repeated time and again. It may, however, be noted that Sir William Crookes died in 1919, not 1920, as given on p. 209. Also, in describing the Carlsbad (Karlovy Vary) Sprudel Salts, the author gives this spa as in Austria instead of Czechoslovakia. Finally the figure 2 is missing in the formula for stannites, M_2SnO_2, although it should be pointed out that there is no evidence of the existence of such compounds. Actually "stannites" contain hydrogen and are best represented, HSnOOM (*The Chemical News*, 1920, cxx, 229; 1923, cxxvii, 306.)

The use of such spelling as sulfur may not be received very enthusiastically by English chemists, who will nevertheless be relieved, on turning back, to find phosphorus under P and not under F.

Summing up, it will be seen that little but praise can be bestowed upon Prof. Hackh for his important contribution to the works of reference on chemistry.

J. G. F. DRUCE.

NOTICES OF BOOKS.

Diatomaceous Earth. By ROBERT CALVERT. Pp. 251. New York: Chemical Catalog Co. 1930. Price 5 dollars.

This is an exceptionally good monograph (in the series issued by the American Chemical Society) on an important, growing and little understood subject. It is written in an agreeable style, and the author has evidently taken great pains to compile a complete, informative and accurate work.

Diatomaceous earth consists of the fossil remains of the unicellular organisms known as diatoms. It has sometimes been inaccurately termed infusorial earth upon the supposition that the fossil organisms were infusoria. It is chiefly composed of silica but should not be confused with powdered pumice, fuller's earth, "colloidal clay," and other abrasives and absorbents of entirely different nature. The uses to which diatomaceous earth (diatomite or keiselguhr are alternate names) can be put are many and are increasing, hence it is often marketed under obscure trade names. Among its more important uses mention may be made that it is used for filtration purposes (*e.g.*, cane sugar solution, molasses), as a "filling" and in making thermal insulators. It has been used successfully in "splitting" oil and water emulsions and its annual production in Canada, U.S.A., Ireland and Central Europe is on the increase.

All these things are touched upon by Mr. Calvert in his valuable book which describes the manner of obtaining diatomaceous earth, its preparation for the market, its properties and how it can be used. He has drawn considerably upon the patent literature in making his survey of the subject, and the monograph can be heartily commended to the attention of chemists and industrialists.

Forthcoming Events.

SOCIETY OF PUBLIC ANALYSTS.

Wednesday, February 5, at the Chemical Society's Rooms, Burlington House, W.1., at 8 p.m. The following papers will be read:—

"The Determination of Minute Amounts of Iodine in Soils and Waters." By R. L. Andrew.

"Preliminary Studies in the Bacteriology of Wheat and Flour." By D. W. Kent-Jones, Ph.D., B.Sc., F.I.C., and A. J. Amos, B.Sc., A.I.C.

"The Separation of Metals by 'Internal Electrolysis.'" By H. J. S. Sand, D.Sc., Ph.D., F.I.C.

"The Rapid Determination of Bismuth and Copper in Lead Bullion by Internal Electrolysis." By Ella M. Collin, B.Sc., A.I.C.

"Notes on the Thiocyanate Method of Determining Iron. Influence of Different Classes of Phosphates. By G. Winthrop Leeper, M.Sc.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Monday, February 3, at 5 p.m.—General Meeting.

Tuesday, February 4, at 5.15 p.m.—"Isotopes" By Dr. F. W. Aston, F.R.S.

Thursday, February 6, at 5.15 p.m.—"Radio Direction Finding by Transmission and Reception." By Dr. R. L. Smith-Rose.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, London, W.C.2.

Wednesday, February 5, at 8 p.m.—(Ordinary Meeting.) Sir William Clare Lees, O.B.E., Member of the British Economic Mission to South America, "Some Aspects of the Question of Trade with South America." Sir Edward T. F. Crowe, C.M.G., Comptroller-General, Department of Overseas Trade, will preside.

Friday, February 7, at 4.30 p.m.—(Indian Meeting.) G. H. Tipper, M.A., F.G.S., M.I.M.M., late of the Geological Survey of India: "Recent Mineral Developments in India."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

151.—Cahn, F. J.—Manufacture of organic acids. January 2.

424.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.) — Manufacture of water-soluble condensation products of unsaturated fatty acids. January 4.

425.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.). — Manufacture of alkyl, etc., derivatives of carbohydrates. January 4.

Specifications Published.

293,302.—Polanyi, Dr. M., and Bogdandy, Dr. S. von.—Synthesis of chemical substances.

Abstract Published.

321,737.—Dyeing. — Carpmael, A., 24, Southampton Buildings, London; I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Azo dyes, forming upon the material.—Diazoniumfluorosulphonates obtained by reacting on diazonium compounds with fluorosulphonic acid are combined with coupling components on the fibre. In examples the following dye-stuffs are produced on cotton yarn the shades being as stated. (1) 4-Nitrobenzenediazoniumfluorosulphonate $\longrightarrow$ 2 : 3-hydroxynaphthoic anilide, vivid red; (2) 3 : 3'-dimethoxydiphenyl-4 : 4'bisdiazoniumfluorosulphonate $\longrightarrow$ 2 : 3-bydroxynaphthoic-α-naphthalide, blue; (3) 2 : 3'-dimethylazobenzene - 4' - diazoniumfluoro - sulphonate $\longrightarrow$ 2 : 3-hydroxynaphthoic-α-naphthalide, garnet; (4) 5-benzoylamino-2 : 4-dimethoxyphenyldiazoniumfluorosulphon-

ate → 2-naphthol-3-carboxylic acid-2'-toluidide, violet.

5-Benzoylamino-1-amino-2 : 4-dimethoxybenzene is prepared from *1-amino-2 : 4-dimethoxybenzene by benzoylation, nitration and reduction.*

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

498,703.—Illustration of a shell and the words SHELL BRAND. — Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes, all being goods only for export to and sale in markets *other than those of the Irish Free* State, but not including mustard, mustard oil and mustard preparations.—The Asiatic Petroleum Co., Ltd., St. Helen's Court, Great St. Helens, London, E.C.3. January 8.

ALBOLINEUM.

507,622.—All goods in class 2 which includes *chemical substances used for agri*cultural, horticultural, veterinary and sanitary purposes.—Cooper, McDougall & Robertson, Ltd., Chemical Works, Ravens Lane, Berhamsted, Hertfordshire. January 8.

BROMOR.

505,910.—Photographic chemicals, etc.— Union Chimique Belge Societe Anonyme, 61, Avenue Louise, Brussels, Belgium. January 8.

SITOBROM.

505,904.—Photographic chemicals, etc.— Union Chimique Belge Societe Anonyme, 61, Avenue Louise, Brussels, Belgium. January 8.

POETRY OF SCIENCE.

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They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

CELLULOSE UNDER X-RAYS.

SIR WILLIAM BRAGG'S LECTURE.

At the Royal Institution on January 24, Sir William Bragg dealt with the X-ray analysis of cellulose. In referring to the elements he reminded his hearers that oxygen atoms made up half the known world, silicon and aluminium the greater part of the other half. Most of the 90 kinds of atoms might be said to be present in traces only. The seas gave to the water molecule easy precedence over others; in the rocks combinations consisting mainly of oxygen and silicon were predominant.

Carbon atoms were very small in number in comparison with all that the earth contained; but they had a special distinction because they were used so largely for the building of living things. Their combinations with other atoms, especially oxygen, nitrogen, and hydrogen, were dealt with in organic chemistry. An infinite number of such combinations could be conceived; yet a very few were singled out for almost universal employment. There was the long-chain type, of which the links were made of carbon. these were the fats, greases, paraffin, and the like. A second type was built on the "benzene" ring, of which the core consisted of six carbon arranged in a hexagon. This was the basis of many dyes, explosives, and drugs of various kinds.

Cellulose was the fundamental molecular combination occurring in vegetable growth. One had but to remember that trees and shrubs, grasses, and plants of all kinds were mainly composed of cellulose to be struck with the strangeness of such a sharp selection. The chemists had shown that cellulose was essentially some multiple of a certain group of atoms, six carbons, 10 hydrogens, and five oxygens. They had also been able to show fairly completely how the atoms in this group were attached to one another, which to which. They had shown that the six carbons were arranged in a sequence. They did not, however, make a long chain. Five of them with the oxygen made a ring, and the remaining carbon with certain attachments hung therefrom. The construction was the basis of the structure of plant life.

From the X-ray analysis it appeared that cellulose was composed, in large part at least, of a mass of small crystals. That the same diagram was obtained from all fibres, even from animal cellulose, showed that we were dealing always with the same substance. It could be deduced by measuring up the spaces on the diagram that there was in each crystal a periodicity parallel to the direction of the fibre; and such a periodicity fell naturally into a scheme hinted at by the chemical results. The essential feature thus supported by both X-ray and chemical evidence was the long chain of many links. The bonds that tied the links together were far stronger than those that tied the chain together. There seemed ground to suppose that bundles of these long chains formed "crystallites," small crystalline masses, of which the cellulose was largely composed. When a thread was stretched the X-rays showed that these bundles went more and more into line. When the stress was too great the bundles began to slide past one another, and if the force was too great they let go and the thread broke.

Thus the basis of fibre in Nature was really this elemental fibre of rings in a series. The thread or the rope was a reproduction on a large scale of a process which Nature had already begun on a scale infinitely smaller. The diamond was extremely rigid because these strong bonds were exerted in every direction. but here were strong bonds in one direction only, and this was the basis of fibre. Fibre had a direction. and there must be direction where was growth. The interest lay in the strange yet simple way in which Nature laid down the fibre structure. The method involved regularity in the arrangement of the atoms; and that was how the X-rays were able to detect it .

FUELS IN CANADA IN 1929.

Production of fuels showed a net gain in value of 3 per cent., the total being $76,116,000. Coal production amounting to 17,499,846 short tons, valued at $62,965,000 was slightly less than the 1928 output in respect of both quantity and value.

The commercial production of natural gas from Canadian wells in 1929 totalled 24,514,200 thousand cubic feet worth $9,202,000, a gain of 8.5 per cent. in quantity and 7 per cent. in value, the greatest increase being in Alberta, where an output of 16,274,000 thousand cubic feet was recorded as compared with the 1928 total of 14,288,605 thousand cubic feet. There was little change in the quantity produced by New Brunswick and Ontario wells.

Petroleum output totalled 1,132,800 barrels valued at $3,945,000, representing an advance of 81.6 per cent. in quantity and 93.8 per cent. in value, Alberta's production being approximately 1,000,000 barrels.

THE CHEMISTRY OF DVI-MANGANESE, ELEMENT OF ATOMIC NUMBER 75.

By J. G. F. Druce, M.Sc. (Lond.), R.Nat.Dr. (Prague), F.I.C.

The discovery of two new elements of atomic numbers 43 and 75 was announced in 1925 by Noddack and Tacke who claimed to have detected them in platinum ores and in certain columbite minerals.

The presence of any unknown elements in platinum ores in appreciable amounts was subsequently denied by Zvjaginstsev, and Prandtl cast doubt upon the presence of these elements in columbites. Nevertheless, I. and W. Noddack have since been able to obtain enough material containing the element of atomic number 75 (which they have called Rhenium whilst assigning also the name Masurium to the element of atomic number 43) to establish its existence.

The occurrence of dvi-manganese in crude manganese compounds was discovered independently by Loring and Druce and by Dolejsek and Hevrovsky. Since the amount of the new element in commercial manganese compounds is small (it is estimated to be about one part in 20,000), its isolation from this source has proved most tedious, but sufficient evidence has accumulated to prove beyond dispute the existence of this element.

Method of Extraction.—There is some reason to suppose that the sulphide of dvi-manganese would be soluble in ammonium sulphide, like that of chromium. Thus the earlier attempts at separating the new element from manganese compounds consisted in removing manganese as sulphide from alkaline solutions, and then examining the filtrates for dvi-manganese. In this way preparations estimated to contain 1 to 2 per cent. of dvi-manganese were obtained. When these are heated in a stream of hydrochloric acid gas they give a volatile higher chloride of dvi-manganese which, together with the excess of hydrochloric acid, is retained in a wash-bottle containing water. This solution, on electrolysis, gives a bright silvery-grey deposit on the cathode. The metallic deposit of dvi-manganese is readily soluble in hydrochloric acid, giving a very pale green solution which yields no precipitate with sodium or ammonium hydroxide solutions. The metal ignites readily in the air, emitting a white fume of the volatile higher oxide as it burns away.

Heyrovsky, who detected the presence of the element in manganese solutions by means of the dropping mercury cathode, prepared products rich in dvi-manganese by dipping strips of zinc or platinum into concentrated manganese solutions and by the addition of manganese amalgam to similar solutions. The deposits so obtained were all found, on X-ray examination, to contain the new element.

The methods used by the German investigators were at first rather involved, and it is to be supposed that they have since simplified the process as originally given. The procedure consisted in heating the powdered columbite with sodium hydroxide and nitrate so that iron and the earthy metals remained insoluble. After separating most of the niobium and tantalum, the manoxide. The filtrate, coloured yellow with sodium chromates, was repeatedly saturated with hydrogen sulphide and acidified in order to obtain the sulphide of the new elements together with those of about twenty other elements present in columbite. Treatment with nitric acid removed most of the remaining niobium, tantalum, and tungsten. Addition of alkali then separated out most of the iron, cobalt, nickel, manganese, tin, and copper, and left a product containing 1 to 5 per cent. of the new element. More recently, in treating alvite and gadolinite, these authors first removed molybdenum as ammonium phospho-molybdate and effected the final purification by fractional sublimation of the volatile oxide. This gave a product containing only minute traces of other metals (molybdenum, arsenic, antimony, and lead).

When the sulphide is heated in a stream of hydrogen, it leaves the metal in a form which readily burns to one of the oxides on heating in air. The atomic weight of the element has been estimated from the ratio of the metal to sulphur in the sulphide by this process. It is given by the Germans as 188.7.

The Oxides.— The most exhaustive and complete work on the oxides of the new element has so far been carried out by I. and W. Noddack. So far five oxides have been obtained and described :

D_2O_8, a white amorphous volatile solid, m.p. 150-155° .

D_2O_7, a hygroscopic yellow solid, melting above 220° C. and boiling at temperatures over 450° C.

DO_3, a red oxide obtained on oxidising lower oxides in solution.

DO_2, a (blue-) black oxide.

There are also violet-blue oxides obtained by reducing the higher ones with sulphur dioxide or carbou monoxide whilst they are heated in a suitable tube. Their composi-

tion is said to correspond with the formula D_3O_8.

When impure dvi-manganese is heated in oxygen, the lower oxides are the main products. If the metal is heated in oxygen to 200° C. it glows and emits a thick white smoke which on analysis corresponds with the composition DO_4, but the formula D_2O_8 is suggested to accord with the maximum valency of seven which dvi-manganese should possess. When the element is heated more strongly in oxygen, the vapour condenses to yellow drops which solidify on cooling to crystals of D_2O_7. As these can be distilled unchanged, this oxide has been used for a molecular determination by ictor Meyer's method, and gave the value of 502 (at 520° C.); the theoretical value is 490 for this compound.

The black oxide is basic and will dissolve in sulphurous acid. The solution, on continued boiling, gives the sulphate of dvi-manganese. This oxide in nitric acid solution gives a reddish colouration owing to the formation of the red oxide, DO_3. Caustic soda turns it yellow and forms the dvi-manganate from the solution of which lime water and baryta water precipitate the yellow insoluble dvi-manganates of calcium and barium.

When the yellow oxide D_2O_7, dissolves in water it yields an acid like $HMnO_4$ and $HClO_4$, which is capable of dissolving the hydroxides of iron, aluminium, and zinc, and which will also react with iron and zinc, evolving hydrogen. The acid is reduced by means of zinc and sulphuric acid and by hypophosphorus acid, but is re-oxidised on shaking in the air. Among the salts that have been obtained are those of potassium, sodium, ammonium, and barium by neutralisation, and the silver salt which is obtained as a white precipitate on adding silver nitrate solution to the sodium salt solution.

The Chlorides.—Dvi-manganese forms a volatile higher chloride, possibly DCl_7, although the Noddacks regard it as a hexachloride, and also a non-volatile lower salt, DCl_2.

According to Dolejsek and Heyrovsky, chlorine prepared by the action of hydrochloric acid upon potassium permanganate contains appreciable quantities of dvi-manganese as the volatile higher chloride. It is now found that the chlorine disengaged on adding a concentrated manganese chloride solution to solid commercial potassium permanganate also contains the new element in combination. When the gas is cooled small green crystals appear, and when passed into barium hydroxide solution a precipitate is formed. The same occurs when the crude oxide is treated with hydrochloric acid gas. With aqueous solutions of hydrochloric acid a deep light green solution has been observed. The green choride was also obtained with an ethereal solution of hydrochloric acid. The chloride is, however, readily decomposed.

The lower chloride, analogous with manganese dichloride, results when the metal is dissolved in dilute hydrochloric acid.

The Sulphate. When the chlorine containing the higher dvi-manganese chloride is absorbed in barium hydroxide solution, a dark precipitate containing the dvi-manganese separates out. This is partly soluble in hot sulphurous acid forming dvi-manganese sulphate, and may be filtered from the barium sulphate simultaneously formed. On evaporation the filtrate leaves a white residue, difficult to crystallise and containing impure dvi-manganese sulphate, contaminated with some manganese. With caustic alkalis, a dark precipitate of the hydrated oxide was formed, which redissolved in excess on exposure to the air by oxidation giving the dvi-manganate.—(Abstracted from *Science Progress*, Jannary, 1930, vol. XXIV, pp. 480-484.)

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Recently Radiostoleum, for instance, has been the subject of considerable research and experimentation.

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Results of later experimentation warrant a wider application of the treatment in maternity hospitals and in the field of general medical practice; in fact it appears that the above-mentioned discovery is likely to exercise considerabl influence upon the maternal mortality rate, not only by its adoption in the actual treatment of puerperal sepsis, but also by the use of Radiostoleum as a prophylactic during the pre-natal period.

Considerable interest has been aroused recently also in the substance S.U.P.36 described last year following the publication by a physician of reports on its value in cases of influenza. S.U.P.36 has been in use for the treatment of colds, influenza, pneumonia, and similar inflammatory conditions of the lungs since 1923, but its remarkable value has not been widely appreciated hitherto.

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Pitch, best known in its medium soft state, can now be produced to specified penetration tests for road work according to buyers' requirements.

Road tar for surface dressing, tar macadam and grouting, may also be had in standard grades and to specification.

Creosote is produced to a variety of specifications for employment in the manufacture of disinfectants and sheep dips, and for wood preservation processes.

Naphthalene is supplied in crude forms and every form and grade up to the highest commercial purity.

The complete series of Benzoles and their allied products are made in large quantities. Benzole, Toluole and Kylole are refined and sold as products of close boiling point range. Soluole, Solvent Naphtha and high flash naphthas are prepared to the specified requirements of the paint, varnish and cellulose dope industries. The main part of the benzole production is sold as motor fuel.

Crystal Carbolic Acid is manufactured to Pharmacopoeia standards, and the liquid Carbolic Acids in standard grades are naphthalene free, and eminently suitable in quality for the manufacture of disinfectants and of synthetic resins.

Dry Neutral non-caking crystal Sulphate of ammonia is another high grade product.

GENERAL NOTES.

FERTILISERS FROM WASTE GAS.

PROGRESS OF GERMAN HEAVY INDUSTRIES' SCHEME.

The progress made in the Ruhr coal and steel industries' scheme for converting their waste coke-oven gas into valuable synthetic nitrate fertilisers is described in a recent report issued by the Ruhr Chemical Co. This concern, which was founded two years ago by the German Steel Trust, Krupp's and other leaders of heavy industry in the Ruhr, with the financial backing of the Dillon Read banking interests of New York, started production last year with plant capable of turning out 16,000 to 20,000 tons of nitrogen a year. By 1931 the company expects to be producing about 50,000 tons of fertilisers and to be absorbing 250 million cubic metres of gas, which, until the inauguration of this scheme was flaming as waste into the air.

Germany is at present producing about 800,000 tons of nitrogen a year, about one-third of which is exported. Although the Ruhr enterprise, utilising a by-product of the industries by which it is owned, and availing itself of the cheap transport provided by the Rhine, is able to produce considerably more cheaply than other concerns, it is not undercutting prices, but has concluded a sales agreement with the powerful German nitrate syndicate, which is in turn linked up with international interests responsible for 90 per cent. of world production of nitrate. A reduction in their price was recently made by the syndicate.

The scheme adopted for the utilisation of the waste coke-oven gas of the Ruhr is one of the most economically comprehensive of all those involved in the process of post-war rationalisation in Germany. The surplus gas, produced in the course of coke-manufacture, is conveyed to the plant of the Ruhr Chemical Co., where 50 per cent. of hydrogen and 8 per cent. to 12 per cent. of nitrogen is extracted. The residue, undiminished in heating value, is returned for use by the steel companies for heating purposes. The hydrogen and nitrogen retained are the

›ases of a valuable artificial fertiliser, while ıumerous by-products, such as liquid ımmonia and nitric acid, have also been urned to commercial use. Continuous esearch is maintained by the enterprise into resh possibilities for its by-products, one of he most important being methane, for which a future is predicted as a motor fuel.

ɛEPORT OF STANDING COMMITTEE ON MALT PRODUCTS.

The Report on Malt Products made by he Standing Committee set up by the Minister of Agriculture and Fisheries, the Secreary of State for the Home Department and he Secretary of State for Scotland, acting ›intly, has now been presented.

Copies of the Report (price 1d.) can be urchased from H.M. Stationery Offices.

OVERSEAS TRADE.

Iarket for Chemicals, Drugs, Fertiliers and Perfumery in Salvador, Iicaragua, Guatemala and Honduras.

A confidential report on the market for hemicals, drugs, fertilisers and perfumery ı the above mentioned Republics has been repared by the Department of Overseas Trade from information furnished by His Iajesty's Consular Officers at San Salvador, Ianagua, Guatemala and Tegucigalpa, espectively, and issued to firms whose ames are entered on its Special Register.

United Kingdom firms desirous of receivıg a copy of this report, together with pariculars of the Special Register service of ıformation and form of application for egistration, should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

ɛEMARKABLE TINNING COMPOUND.

Solving Engine-Makers' Problems.

Canadian Invention to Aid Industry.

A new compound for tinning cast-iron—which will facilitate the manufacture and ıcrease the efficiency of Diesel engines as well as air compressors and other machinery where bearings are subject to heavy presıre is announced in the January issue of *in*, published January 20. The compound, hich was discovered by a Canadian, consts of a powder composed of pure tin and secret flux. The object to be treated is eated to a suitable temperature, and the owder is then sprinkled over it.

" This material," states *Tin*, " will tin ny metal except aluminium, without preious cleaning and the tin not only drives ıe dirt off the metal, but actually forms ın alloy with considerable interpenetration. One of the most valuable uses of this compound is its ability to tin cast iron, even when the iron is rusty, and several manufacturers of engines which use white-metal bearings in cast iron shells have already adopted this method of tinning since it enables them to solder the white metal to the shell.

" Soldering is no doubt a far better method of securing the white-metal than the common means of anchoring it with some form of dove-tail to prevent the liners from becoming loose. A not uncommon trouble with anchored liners is for the oil to penetrate between the liner and the shell which still further tends to make the liners move in the shell.

" The ease with which cast iron can be tinned, and the resultant security of the bearings, should prove of great benefit to the makers of Diesel and semi-Diesel engines as well as for air compressors and other machinery where the bearings are subject to heavy pressure."

MINERAL PRODUCTION OF BRITISH COLUMBIA, 1929.

New Record Total of $70,000,000.

According to the Canadian Official Mining News Letter circulated by the High Commissioner of Canada in London recently, the gross value of the mineral production of British Columbia last year was estimated at $70,030,976, an increase of $4,658,000 during the twelve months. Dividends distributed during the year reached a total of $12,500,000, an increase of $1,000,000 as compared with 1928.

Larger tonnages produced at the Sullivan and Britannia mines brought the output of the Province's metalliferous mines from 6,241,310 tons of ore handled in 1928 to 6,600,000 tons in 1929. Higher prices for copper and lead as compared with those of 1928 are responsible for the advance in total valuation. Output of non-metallic minerals and structural materials increased, while coal showed a decrease of 212,000 tons, or $1,000,000 below the 1928 output.

For the first time copper production exceeds 100,000,000 pounds. The average value of the red metal was 18.107 cents a pound, as compared with 14.57 cents in the previous year. Consequently a new high record for valuation has also been established. The figure of $18,650,210, compares with the previous record of $17,784,494 in 1916, when the average price of copper was 27,202 cents a pound.

Gross production of coal during the year is estimated at 2,318,900 long tons, a decrease of 8.5 per cent.

SOME BENEFITS OF SMOKE ABATEMENT.

The Science Committee of the Royal Institute of British Architects has issued a very suggestive Report on smoke abatement. The Report states that striking evidence has been given as to the serious damage occasioned to public and other buildings by smoke and other impurities in the atmosphere. The damage is mainly due to the sulphurous and sulphuric acids contained in the products of combustion, but particles of soot united with these acids materially enhance their injurious effect. The acids become concentrated and the tarry content of the soot makes the mixture more adhesive.

In such buildings as the Houses of Parliament, Buckingham Palace, Somerset House, and Chelsea Hospital, what are the normally good weathering stones are being rapidly disintegrated by the acid soot. It has been given in evidence that the upkeep of public monuments and buildings would be reduced by at least one-half if a pure and smoke free atmosphere could be obtained. Sulphuric acid particularly corrodes or disintegrates practically all kinds of building materials. Marble tends to turn green and then black. The absorption of sulphur gases by limestones resulting in the formation of gypsum is, in this country at least, the most potent cause of their decay.

In the case even of internal frescoes the porous surface of the carbonate of lime provides opportunity for the tenacious lodgment of dirt and for the destructive action of acids. The carbonate is transformed to gypsum. It is so expanded that it loses its binding power, while the painting ground is often destroyed.

Some idea of the destructive effect of soot on buildings may be formed from returns compiled by the Department of Scientific Research during the year 1927-28, when it is realised that in the City of London 595 tons are deposited in a year per square mile of surface and soot deposits three-quarters of an inch in thicness have been scraped off cornices. The soot-fall in other places is given as follows :—

Leeds (suburbs) ...	168	tons	per sq.	mile.
Leeds (industrial)	842	,,	,,	,,
Glasgow	447	,,	,,	,,

Two Classes.

The substances derived from the combustion of soft coal and other fuels which are injurious to stone may be divided, roughly, into two classes :—

Class I.—Those which soil buildings—*i.e.*, carbon, tar, ash, and their various combinations.

Class II.—Those which corrode and in general aid in the destruction and weathering—*i.e.*, sulphuric acid, sulphurous acid, hydrogen sulphide, hydrochloric acid, afmonia, and organic acids.

The action of carbon and ash when not associated with tar is not extremely objectionable, as the simple process of dusting will remove either. When, however, they are associated with tar, especially in the case of soot, we have the most objectionable kind of dirt. While the soiling effect of soot is by far the most evident to the eye, it does not in itself cause the deterioration of building material. This cannot be said of the corroding agents, of which sulphuric acid is the most important.

At the present time no method of preservation is known which will adequately protect those building stones which are liable to attack by deleterious acids : the conditions required to be fulfilled by such solutions are mutually contradictory. Temporary protection can be obtained by the use of certain of the many methods of preservation which have been suggested from time to time during the last 80 wears, but the temporary protection so obtained is likely to be followed by an acceleration in the rate of decay. Periodic washing down with water is probably the most effective preventive measure that can be applied in corrosive atmospheres to prevent the accumulation of soot and to keep the stone free from harmful accumulations of disintegrating salts.

Factory chimneys are by no means the chief offenders in emitting smoke which pollutes the atmosphere even in industrial areas. According to the Committee on Smoke and Noxious Vapours Abatement (Ministry of Health) domestic chimneys contribute at the least 50 per cent. of the total smoke nuisance and at least 6 per cent. of the bituminous coal ordinarily burnt in domestic fireplaces escapes, unconsumed, in the atmosphere as soot.

Taking 40,500,000 tons as the amount of coal burnt annually in the United Kingdom (exclusive of Ireland) in its natural condition for domestic purposes, the loss amounts to 2,480,000 tons, or more than half the total amount of fuel required to heat the Metropolitan area for a whole year. That is to say, nearly 2,500,000 tons of soot escape into and pollute the atmosphere every year from domestic fireplaces alone.

Domestic soot contains a considerably higher percentage of carbon and tar than factory soot, and by reason of its large proportion of tar, it adheres to every object upon which it falls, and is, therefore, more obnoxious and destructive than soot emitted from factories.

INFLAMMABILITY OF COAL DUST.

Coal dusts vary greatly in their degree of inflammability. There has not existed hitherto a laboratory test of this inflammability capable of replacing satisfactorily the laborious and rather costly method of repeated trial in large-scale explosion galleries. Now, however, such a test has been evolved and is described in the Safety in Mines Research Board Paper No. 56 by A. L. Godbert and R. V. Wheeler (Stationery Office, price 6d. net). The method of test is to measure the inflammability by ascertaining the proportion of inert dust necessary to suppress inflammation when small quantities are blown by oxygen through a heated tube. It has been proved to give results comparable with the explosion gallery trials. A refinement of the same test has been nsed to study the effect of the fineness and chemical composition of coal dust on its inflammability.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, January 23.

The following papers were read :—

Normal Atmospheric Dispersion as the Cause of the "Green Flash" at Sunset, with Illustrative Experiments. By LORD RAYLEIGH, F.R.S.

The ordinary dispersion of the atmosphere near the horizon appears adequate to explain the "green flash." It can be imitated experimentally with a prism of the same dispersive power as the normal value at the horizon, and without making use of lenses.

The Photometry of Mass-Spectra and the Atomic Weights of Krypton, Xenon and Mercury. By F. W. ASTON, F.R.S.

The importance of the abundance relations between isotopes of a complex element, and possible methods of their measurement, are shortly discussed.

A method is worked out and described by which it is possible to deduce relative abundance of isotopes from the photometry of their lines in mass-spectra with sufficient accuracy for a preliminary survey. Numerical results are given for the six isotopes of krypton, nine isotopes of xenon and seven isotopes of mercury.

The "isotopic moment" of an element is defined and its value given for these three elements. Atomic weights of krypton, xenon and mercury are worked out from the abundance results. That of mercury is in good accordance with the accepted value. For the other two, new values are obtained, which suggest that those deduced from the densities, which are in use at present ,are about 1 per cent. too low.

A New Connection Between the Absorption Spectrum of Hydrogen and the Many-Lined Spectrum. By O. W. RICHARDSON, F.R.S.

A Theory of Electrons and Protons. By P. A. M. DIRAC. Communicated by R. H. Fowler, F.R.S.

An idea is put forward for getting over the difficulty of the existence, in the relativity quantum theory of the electron, of states of negative energy. It is proposed that nearly all the states of negative energy are occupied, so that an electron in a state of positive energy cannot jump into them, by the exclusion principle. A state of negative energy that is not occupied may then be identified as a proton, as it will appear to have a positive energy and positive charge.

The following papers were read in title only :—

On the Problem of Hydro-dynamic Stability. I. By R. V. SOUTHWELL, F.R.S., AND L. CHITTY.

The paper deals with stability of steady shearing motion in a viscous fluid, and as a preliminary discussion indicates the complexity of the prowlem and disposes of certain methods proposed for its solution.

The main conclusions may be summarised :—

(a) None of the methods suggested as alternatives to the "method of normal coordinates" seem to be applicable.

(b) The method of normal co-ordinates appears to be satisfactory for infinitesimal disturbances, in the sense that a sufficient proof of stability will be to show that all disturbances of normal type have a decreasing time-factor.

(c) Within the range of "Reynold's number" covered by our investigation, all normal disturbances have a decreasing time-factor.

(*d*) The time-factor depends on Reynolds' number in an extremely complicated way. The looped diagrams representing this dependance have no counterpart in ordinary problems of vibration theory.

Some Remarks on the Conduction of Electricity in Metals and upon Allied Phenomena. By T. E. STERN. Communicated by R. H. Fowler, F.R.S.

It is shown, by the theory of electrical Conduction of Sommerfeld, that differences arise between the results of transport and of equilibrium theories when applied to phenomena associated with complete electrical circuits; so that theories of the latter type cannot be used, or can be used only with extreme caution, when applied to such problems. There exist in fact two classes of electrical phenomena associated with electricity in metals :—

(1 Those associated with the flow of electricity in closed circuits, to be investigated only by making use of transport theories; and

(2) Those associated with insulated conductors to be investigated by general equilibrium theories.

Various consequences of this difference—such as difference between cooling effects of evaporation of electrons from insulated and from uninsulated conductors—are investigated. Special phenomena arising in case of non-isotropic conductors are considered.

The Zeeman Effect in the Band Spectrum of Helium. II. By A. HARVEY. Communicated by T. H. Havelock, F.R.S.

Estimates are given of magnitudes of (unresolved) Zeeman patterns in He_2 bands of type $^3D \rightarrow 2P\ ^3\Pi$. Effects are widely different for different initial terms $D\Sigma$, $D\Pi$ and $D\Delta$, and appear to be closely related to uncoupling of electronic orbital angular momentum L from the inter-nuclear axis. When coupling is tight, effects falls off rapidly with increasing rotational quantum number K. With complete uncoupling the effects are considerable and appear to be independent of K. Intermediate cases are observed, and it is concluded that correspondence between the two phenomena is so close that the Zeeman effect may safely be taken as a measure of uncoupling if direct evidence is not available. A few observations on the singlet system were possible, results being generally similar to those for the triplet system. The only bands in the secondary hydrogen spectrum for which Zeeman effects are recorded ($D'\Sigma \rightarrow P'\Sigma$) are closely related to those showing the largest effect ($D^3\Sigma \rightarrow P^3\Pi$) in He_2.

THE ROYAL SOCIETY.

Thursday, January 30, 1930.

The following papers were read :—

Crinkle "A," an Infectious Disease of the Potato. By R. N. SALAMAN. Communicated by Dr. H. H. Dale, Sec. R.S.

This communication deals with the Potato Virus Disease, known as Crinkle, and here spoken of as Crinkle " A "" in contradistinction to a new disease discovered by the author and called para-crinkle. Crinkle " A " was first described by Murphy. The symptoms are described as studied in the variety President grown under glass from diseased tubers from a field plant.

Infection by grafting reproduces the disease in various varieties with certain modifications. In one group the clinical picture is still that of Crinkle, in another it is Mosaic, and in a third, Streak. Infection by needle inoculation produces a reduced set of symptoms in all cases. Instead of Crinkle a mosaic, whilst in those cases where grafting produces fosaic, inoculation causes the faintest mottling or no sypmtoms at all. Inoculation in the streak group may produce either crinkle or streak.

Reasons are given for believing that Crinkle " A " is a complex of two or more viruses.

Infection of Datura with Crinkle " A " gives characteristic reactions—at the same time Datura modifies the virus, lessening its virulence. This effect is shown to be produced by the Datura leaves and not by the tissues of the stem .

Tobacco reacts to Crinkle " A "; passage through tobaccos does not increase its virulence.

Para-Crinkle, a Potato Disease of the Virus Group. By R. N. SALAMAN AND R. H. LE PELLEY. Communicated by Dr. H. H. Dale, Sec. R.S.

The potato virus disease known as Crinkle, a name applied to a certain group of symptoms, has been shown by the authors to comprise two distinct infective diseases. One of these diseases, Crinkle " A " has recently been described by the senior author; the other, para-Crinkle, is here described for the first time.

Para-crinkle is distinguished from Crinkle " A " by the fact that certain varieties, such as President and King Edward, which are highly susceptible to Crinkle " A," are perfect carriers of Para-Crinkle. On the other hand, varieties such as Arran Victory and Arran Chief, which suffer relatively mildly from Crinkle "A," are most seriously affected by Para-crinkle.

Reason is shown for believing that Paracrinkle is due to a single virus, and that its action can be completely destroyed by the products of metabolism of the leaves of Datura. The reaction of Datura to the two Crinkles offers a satisfactory basis for distinguishing between the two viruses.

There is reason to believe that the virulence of the virus is increased in those plants which are themselves raised from diseased tubers.

Difference of symptoms following on different methods of infection is observed in this disease, as it was in the case of Crinkle "A."

The Formation of Lactic Acid in Desiccated Amphibian Muscles. By E. C. SMITH AND T. MORAN. Communicated by Sir William Hardy, F.R.S.

The formation of lactic acid in amphibian muscle in the frozen state is due to the removal of water, that is, to desiccation, and to this factor alone.

The peak in the production curve, which occurs at −2.2 to −2.5° C., or at 79 per cent. water removal, is apparently coincident with the point at which death occurs instantaneously in the muscle. These two events cannot be associated with a sudden change in the concentration of any constituent of the plasma of which the behaviour in physiological solution is known.

The Influence of the Host Plant in Inducing Parasitism in Lucerne and Clover Nodules. By H. G. THORNTON. Communicated by Sir John Russell, F.R.S.

When inoculated lucerne seedlings are placed in the dark, formation of fresh nodules soon ceases, and those already formed cease to grow. This is associated with, and probably due to, cessation of cell division in the root. The bacteria become parasitic upon the host tissues, destroying cytoplasm and nuclei of the infected cells and invading the cell walls and intercellular spaces.

In old nodules in lucerne and clover, growing in the light, bacteria behave similarly. Swollen forms in cytoplasm, after destruction of host nucleus, break up into granules which eventually disappear, while coccoid rod forms from the old infection threads invade cell wall and intercellular spaces, causing the nodule to disintegrate.

It is suggested that in both these cases the change in behaviour of the bacteria is due to lack of carbohydrate, and that where this is limited they derive their energy from the host tissue.

Papers read in title only :—

Physiology of Fruit. I.—Changes in the Respiratory Activity of Apples during their Senescence at Different Temperatures. By F. KIDD AND C. WEST. Communicated by F. F. Blackman, F.R.S.

The rate of CO_2 production by apple fruit in senescent phase, after gathering, rises for a period and then falls off continually, until the fruit dies as the result of invasion of the tissues by fungal organisms. The acceleration and deceleration of respiration rate have high temperature coefficients.

The question of the influence of substrate concentration is examined, and it is concluded that the rise and fall in respiratory activity, which accompanies senescence at all temperatures, is not due to changes in substrate concentration related to hydrolysis of sugars, starch or cell-wall materials, but to a change in state of the protoplasm.

The question how far this phenomenon is a general one in the senescence of plant tissues is discussed.

The "Nucleal Reaction" in Apanteles sp., with Special Reference to the Secondary Nuclei and the Germ Cell Determinant of the Egg. By R. N. MUKERJI. Communicated by J. P. Hill, F.R.S.

The secondary nuclei and the germ-cell determinants in the oocytes of Apanteles contain no chromatin and do not originate from the chromatin of the head-nucleus. The basophilic constituents of the germ-cell arre not dissolved away by acid hydrolysis. The germinal vesicle at the end of the prophases of heterotypic division gives a negative reaction to Feulgen's staining. There is no emission of chromatin from the follicular cells into the oocytes or the mature eggs.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

JANUARY EXAMINATION, 1930.

Examination in General Chemistry for the Associateship :

Abbott, William James (The Polytechnic, Regent Street, London); Brierley, Frank (College of Technology, Manchester, and The Polytechnic, Regent Street, London; Broohouse, Frank, B.Sc. (Lond.) (University College, and The College of Technology, Leicester); Evans, Charles Livesey (The Technical College, Birmingham; Field, William Thomas, B.Sc. (Lond.) (The Technical College, Birmingham); Kramrisch, Bernard (The Technical College, Bradford).

SOCIETY OF GLASS TECHNOLOGY.

January 15.

The following papers were presented :—

The Influence of Manganese Oxide on Some Properties of Glass. By A. A. CHILDS VIOLET DIMBLEBY, M.Sc., F. WINKS, M.Sc. Tech., AND PROF. W. E. S. TURNER.

In order to investigate the effect of manganese oxide in some of the properties of glass three series of glasses were made, the melting being carried out in open sillimanite pots. The materials used were sand, limestone, soda ash, manganese dioxide, hydrated alumina, and ferric oxide.

The parent glass of the first series was intended to have the composition SiO_2 72, CaO 10, Na_2O 18, and the series developed by the substitution of soda by manganese oxide to the extent of 0.5, 1.0, 2.0, 3.0, 4.0, and 5.0 per cent.

The second series was developed, the parent glass of composition SiO_2 70, CaO 10, Al_2O_3 2, Na_2O 18, MnO again being introduced at the expense of Na_2O, as in the first series.

The third series were based upon the parent glass SiO_2 68, CaO 10, Al_2O_3 2, Fe_2O_3 2, Na_2O 18, MnO again replaced Na_2O in the proportions stated above.

1. *Melting and Working Properties.*—(a) Refining Time. In the first and second series the introduction of even 0.5 per cent. of MnO resulted in a remarkable reduction in the refining time. In the third series the first glass refined very readily, but this glass contained about 2 per cent. of Fe_2O_3, a colouring agent. The addition of MnO did not affect the refining time until some 3 per cent. was present, and then the reduction was not very great. (b) Working Temperature. The working temperature of the glasses in series one and two fell gradually from 1230° to 1140°, while in series three the working temperature of the parent glass was only 1050°, a rise to 1120° taking place up the series.

2. *Colour.*—Although the glasses contained no potash, the colours were pleasing, ranging from pale pink through darker red, and claret, to black, in series one and two. The dark coloured glass was obtained when 3.0 per cent. MnO was present. In the third series the colours ranged from light green, through yellowish green, light amber, to a darker amber. No glass of this series was as dark as those with 3.0 per cent. MnO in the other series.

3. *Chemical Durability.* The percentage losses in weight of all the glasses in powder form, when boiled for one hour in water, according to the standard method employed in the Department, had been determined, along with the soda extracted in the test. The percentage losses in weight of the glasses when boiled in hydrochloric acid, sodium carbonate, and caustic soda, had also been determined. All the results were shown graphically and demonstrated that the replacement of soda by manganese oxide was in all cases beneficial. The improvement in the resistance to attack by alkaline solutions was very slight in the last series of glasses.

4. *Thermal Expansion.* The thermal expansion coefficients of all glasses had been determined, and the relation between the extension per c.m. plotted against the temperature. These curves exhibited definite " change points " below the incipient softening temperature. The results showed that for all the three series, the replacement of Na_2O by MnO resulted in a lowering of the thermal expansion coefficient, and a raising of the anneealing temperature.

Note on the Formation of Sodium Sulphate in Glass Tank Furnaces. By PROF. W. E. S. TURNER.

Professor Turner said his remarks were given mainly in the nature of a warning. He was often called upon to diagnose white spots in glass such as were seen in various specimens exhibited. These varied from small elongated spots, to large, dense white splashes, and were shown in bottles and jars. These splashes were encased in the glass, but on fracture the glass surface was easily separated, revealing a fine white powder inside. Chemical analysis had proved this powder to be sodium sulphate in all the cases examined, yet no salt cake was used in the glass batch. The soda ash from the batch had reacted with the sulphur content of the furnace gases, producing this white sodium sulphate. Samples of coal taken from the the normal stock at works where the sodium suphate trouble had been experienced, had been analysed for sulphur content, and values ranging from 1.35 to 3.41 per cent. had been obtained.

The Physical Properties of Soda-Silica Glasses. Part I. The Thermal Expansion. By PROFESSOR W. E. S. TURNER AND F. BINKS, M.Sc.Tech.

Homogeneous soda-silica glasses were prepared from pure quartz and anhydrous sodium carbonate. The melting was conducted in a large platinum crucible in an electric furnace. In order to eliminate attack by the batch on the platinum, each batch was sintered first in a large silica cru-

cible. Each glass was stirred with a platinum stirrer, was poured, crushed, replaced in the cleaned crucible, re-melted, re-stirred, and poured again. The thermal expansions of the glasses were determined over ranges extending from room temperature to the upper annealing temperatures. Glasses containing between 51 and 77.5 per cent. SiO_2 exhibited four "change points" in the curves, while glasses with higher SiO_2 contents ,up to, say, 85 per cent., exhibited only two such breaks. Curves were also given showing the relation between the coefficient of expansion and the silica content of the glasses. Factors were derived for SiO_2 and Na_2O over the ranges studied. Good agreement was obtained between the new work and the work published previously by S. English and W. E. S. Turner, but the values were quite different from those published by M. Samsoen, except for glasses containing 60-80 per cent. SiO_2 where moderate agreement was obtained.

ELECTROPLATERS' & DEPOSITORS' TECHNICAL SOCIETY.

(Associated with the Faraday Society.)

CONVENTION AND EXHIBITION.

The Society held a Convention on Friday, 31 January, at the Northampton Institute, Clerkenwell, London, E.C.1.

An Exhibition representative of modern scientific and practical advances in electrodeposition was on view at the Institute during the day.

Dr. W. Rosenhain, F.R.S., of the National Physical Laboratory, Teddington, delivered an address on "Researeh and Practice." and a discussion took place on "The Present Position of Chromium Plating."

INADEQUATE SUPPLY OF BRITISH CATALOGUES FOR NEW ZEALAND.

H. M. Trade Commissioner in New Zealand reports that complaints are still received from local importers to the effeect that a number of British manufacturers do not supply to their agents an adequate number of catalogues. Merchants in New Zealand are kept well supplied with up-to-date catalogues of foreign manufacturers, and, as a result, they frequently take the line of least resistance and order from foreign manufacturers goods which they would more readily buy from Great Britain if suitable catalogues were available. The agents of United Kingdom manufacturers create an interest in the products of their principals, but unless the local merchant is able to refer to a catalogue when the day for ordering arrives, the order may frequently be lost to the British firm, through no fault of the agent.

The Trade Commissioner attaches the greatest importance to this matter and hopes that United Kingdom manufacturers who do not already do so, will make arrangements so that their agents are supplied with an adequate number of up-to-date catalogues for distribution.

NATIONAL MARK MALT EXTRACT.

With the co-operation of the Retail Pharmaceutists' Union, the Ministry of Agriculture and Fisheries has issued to over 7,500 retail pharmaceutists in England and Wales a letter ,inviting their co-operation in placing upon the market National Mark malt extract (with oil) which is now being produced by a large number of malt extract manufacturers in this country. The malt extract is made entirely from home-grown barley to very high pharmaceutical standards designed to ensure the maximum nutritive and medicinal value for the produet.

National Mark malt extract and oil has been available since the 8 January last, and already very encouraging reports have reached the Ministry of its reception by the pharmaceutical trade. The National Mark Malt Extract Scheme is of great benefit to the public in establishing guaranteed high standards for a food and medicine which is in universal demand. In order to be sure that they are obtaining the genuine article, all purchasers of National Mark pharmaceutical malt extract and oil should look for the dark blue ribbon and seal with a National Mark which is placed upon all genuine supplies.

ROYAL INSTITUTION.

At a General Meeting of the Members of the Royal Institution held on February 3, Sir Robert Robertson, Treasurer and Vice-President, in the chair, Mr. R. Appleyard, Sir Herbert Baker, Mr. A. Carpmael, Mrs. Drysdale, Commander R. T. Hanson, Col. G. C. I. Hervey, Commander H. L. Hitchins, Mr. R. W. King, and Mr. G. P. Shakerley were elected Members.

NOTICES OF BOOKS.

The British Journal Photographic Almanac 1930. Ed.: GEORGE E. BROWN, F.I.C. Pp. 784 and 64 pages of photogravure supplements. London: Henry Greenwood & Co., Ltd., 24, Wellington Street, W.C.2. Price 2s. net (paper covers); 3s. net (cloth bound).

To the vast multitude of photographic amateurs photography appeals simply because it is an easy and delightful way of picture-making. For this same reason the new 1930 volume of the *British Journal Photographic Almanac* is a book that no camera-user can afford to be without. Its many examples of pictorial works, beautifully reproduced in photogravure, and its pages of reviews of the newest equipment and aids for photographing, claim the interest of those to whom photography means pictures. Those who are interested in it as a craft will again, of course, find the reference and technical sections that have been so well esteemed in the past. For readers of both classes, equally, there is a rich source of interest in this year's literary pages. Mr. T. L. J. Bentley writes in practical fashion for the snapshot-maker, suggesting the great usefulness of telephoto lenses, and a pictorial section contributed by Mr. David Charles forms a most valuable collection of technical hints.

The "Epitome of Progress" occupies about 70 pages. It would seem that much attention is now being paid to improving and simplifying cine-photography. In the application of chemical knowledge an account is given of a patented silver-free process of extra-sensitising methods, of new desensitisers, special developers, or remedying defects and generally improving the various chemical processes by which the latent image is developed and fixed.

Perhaps the most interesting feature is the Editor's account of the stages through which photography has passed in his lifetime and during the twenty-five years he has edited this indispensable *Annual*. He tells of curious methods and apparatus which enjoyed brief notoriety and relates his amusing experiences with many of the personalities whom he met in the course of his long association with photography. These alone should not be missed by anyone interested in the subject either from the technical side or as an amateur.

Exact Colour Matching and Specifying. By L. BLIN DESBLEDS. Pp. 116. Paris: Technological and Industrial Service, 41, Avenue Gambetta. 1930. Price 4 shillings.

This volume, by a French colour technologist, attempts to convey a clear conception of the essentials in colour matching and suggests means of specifying for an exact match of a given dye. The author deals with the factors which influence colour sensations, the "colour curve" and its interpretation and its use as a practical working instrument.

It is pointed out that whilst the neccesity for modern industry of being highly scientific is generally recognised, dyeing is still an empirical art. The physicist and physiologist and again the dyer, look upon colour phenomena from different standpoints.

The urgency of a common understanding on the subject is pressed and a way out indicated.

The Australian Council for Scientific and Industrial Research has recently issued three important pamphlets describing the work of the Divisions of Economic Botany, Entomology and Animal Nutrition for the year 1928-8. These reports have been written by Dr. B. T. Dickson, Dr. R. J. Tillyard, F.R.S., and Prof. T. Brailsford Robertson, the respective Chiefs of the Division.

PUBLICATIONS RECEIVED.

U.S. GEOLOGICAL SURVEY.

The Contact of the Fox Hills and Lance Formations. By C. E. Dobbin and John B. Reeside. (158-B.)

Surface Water Supply of the United States, 1925. Part VII. Lower Mississippi River Basin. By N. C. Grover (Paper 607). 20 cents.

Surface Water Supply of the United States, 1925. Part VIII. Western Gulf of Mexico Basins. By N. C. Grover. Paper 608. 30 cents.

Surface Water Supply of the United States, 1925. Part IX. Colorado River Basin. By N. C. Grover. (Paper 609.) Price 15 cents.

Surface Water Supply of the United States, 1925. Part X. The Great Basin. By N. C. Grover. (Paper 610). 20 cents.

Surface Water Supply of the United States, 1925. Part XII. North Pacific Slope Drainage Basins. By N. C. Grover. (Paper 613). 30 cents.

Surface Water Supply of the United States, 1925. Part XII. North Pacific Slope Drainage Basins. C. Pacific Slope Drainage Basins in Oregon and Lower Columbia River Basin. By N. C. Grover. (Paper 614). 30 cents.

Suspended Matter in the Colorado River in 1925-1928. By C. S. Howard. (636-B).

The Chandalar-Sheenjek District, Alaska. By J. B. Mertie, Jr. (Bulletin 810-B).

The Kevin-Sunburst Oil-Field and other Possibilities of Oil aud Gas in the Sweetgrass Arch, Montana. By Arthur J. Collier. (Bulletin 812-B.) 30 cents.

U.S. BUREAU OF STANDARDS.

Regain of Mercerised Cottou Yarns. CS11-29.

Dress Patterns. CS13-30.

Wall Paper. CS16.

Forthcoming Events.

LECTURES ON TROPICAL HYGIENE.

The London School of Hygiene and Tropical Medicine (University of London) announce that their next course of lectures on tropical hygiene for men and women (outside the medical profession) proceeding to the tropics will be given daily on March 12 to 14 and 17 to 21, from 5.30 to 7 p.m. Enquiries regarding this and future courses should be addressed to the Secretary, Keppel Street, Gower Street, London, W.C.1.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

Manchester Section.

Friday, February 14, at Milton Hall, Deansgate : " Common Sense and Nitro-cellulose Lacquer." By R. G. Daniels, B.Sc., A.R.C.S., A.I.C.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, W.C.2.

Wednesday, February 12, at 8 p.m.—(Ordinary Meeting.) Holbrook Jackson, Editorial Director of the National Trade Press, Ltd. : " Colour Determination in the Fashion Trades." The Right Hon. Lord Ebury, D.S.O., M.C., will preside.

THE OPTICAL SOCIETY.

A meeting of the Optical Society will be held at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7., on Thursday, February 13, at 7.30 p.m. The President of the Society, Mr. F. Twyman, F.R.S., will deliver his Presidential Address on : "Optics in Radio Transmission and in other Fresh Fields."

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Tuesday, February 11 ,at 5.15 p.m.—" X-Ray Determination of the Structure of Cellulose." By Sir William Bragg, F.R.S.

GEOLOGICAL SOCIETY OF LONDON.

The Annual General Meeting to elect the Council and Officers for the ensuing year will be held at the apartments of the Society in Burlington House, on Friday, February 21, at 3 p.m. The President's Address will be read duriug this meeting.

The Fellows of the Society and their Friends will dine at the Connaught Rooms, Great Queen Street. W.C.2 (nearest Tube Stations. Holborn and British Museum), on the same day (Friday, February 21), at 7.15 for 7.30 p.m.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

725.—I. G. Farbenindustrie Akt.-Ges. —Production of vat dyestuffs. January 8.

1,026.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of strontium oxide. January 10.

1,029.—I. G. Farbenindustrie Akt.-Ges. —Production of 1 : 1 : 2-Trichlor-ethane. January 10.

461.—Imperial Chemical Industries, Ltd., and Horsley, G. F.—Hydration of acetylene. January 6.

Specifications Published.

295,082.—Geigy Akt.-Ges., J. R.—Manufacture of strongly basic azo-dyestuffs.

298,234.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of derivatives of aminoaryl antimony compounds.

Abstract Published.

322,008.—Dyes.—Imray, O. Y., 30, Southampton Buildings, London.—(I. G. Farbeniendustrie Akt.-Ges.; Frankfort-on-Main, Germany.

Anthraquinone vat dyes or their leuco-compounds are prepared by treating a N - alkyl - pyrazolanthrone (Specification

264,503) substituted in the 2-position by a *halogen, sulphonic acid or mercapto group* with an alkaline or neutral reducing agent. The substituent in the 2-position appears to be split off and a bimolecular product formed which is generally a leuco derivative and may thus be used immediately for dyeing processes. Reducing agents used in examples are hydrosulphite, alcoholic sodium sulphide, zinc dust and caustic soda, and magnesium, ammonium chloride and methyl alcohol, and products are prepared from substituted N-methyl- and ethyl-pyrazolanthrones dyeing cotton in red shades from a blue vat. They are identical with the products described in Specifications 14103/15 and 263,494.

2-Halogen N-alkylpyrazolanthrones are prepared by treating the N-alkylpyrazolanthrones with a halogenating agent. The 2-chloro-N-methyl- and 2-bromo - N - ethylpyrazolanthrones are described.

2-Mercapto-N-methylpyrazolanthrone is prepared from the corresponding 2-chloro derivative by treating with sodium sulphide. The 2-methylthioether is prepared by methylating the sodium salt of this mercapto derivative.

N-alkylpyrazolanthrone-2-sulphonic acids are prepared by sulphonating the N-alkylpyrazolanthrones with oleum.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

DUMINOX.

508,707.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.— Samuel Wills & Co., Ltd., Castle Green Colour Works, Castle Green, Bristol. January 15.

GLACTA.

507,830.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes. — E. J. Reid & Co., Ltd., 35, Gordon Sq., London, W.C.1. January 15.

PROTUS.

506,530.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—The Protoid Co., Ltd., Kelvinside, Seacombe, Liverpool. January 15.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

Price 5s. net.

Obtainable from The Manager,
The Chemical News,
Offices : Merton House, Salisbury Square.
London, E.C.4.

WANTED.

Chemical News for January 6, 1928. Good price paid.—Address, Manager, *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

URGENTLY WANTED
TO PURCHASE
CHEMICAL NEWS:

No. 3061. Vol. 117.
also
No. 3400. Vol. 130.

Double Price Paid.

Address—R. M. P., c/o *Chemical News*, Merton House, Salisbury Square, London, E.C.4.

CHEMICAL NEWS:
No. 3123, Vol. 120; dated April 16, 1920.
Good price, and postage, paid.
Also wanted :—
Volume 120; and Volume 123.
Bound or Unbound. Good price.
Address, R. L., c/o *Chemical News*, Merton House, Salisbury Square, E.C.4.

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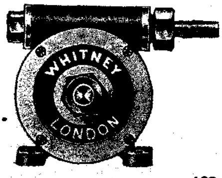

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STAFFORDSHIRE COUNTY COUNCIL.

The County Council invite applications for the post of

SECOND ASSISTANT CHEMIST

for the County Laboratory at Stafford.

Candidates must have a Science Degree or the qualification of the Institute of Chemistry and must have had experience in the work of a Public Analyst's Laboratory.

Commencing salary £220 per annum. The appointment will be subject to the provisions of the Local Government and Other Officers' Superannuation Act, 1922, and to one month's notice on either side.

Forms of Application may be obtained from me, and must be returned together with copies of three recent testimonials, on or before February 15th, 1930.

EUSTACE JOY.

County Buildings,
Stafford.
23rd January, 1930.

THE ROYAL SOCIETY.

Government Grant for Scientific Investigations.

Applications for the year 1930 must be received at the Offices of the Royal Society not later than MARCH 31ST Next, and must be made on Printed Forms to be obtained from the Clerk to the Government Grant Committee, Royal Society, Burlington House, London, W.1.

NOTICE TO AUTHORS AND CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

MATTER AND LOGIC.

By Dr. W. Tombrock.

The Ether of Mendeléeff. I.

And even if it be found impossible to recognise in the ether the properties of the lightest, most mobile, and chemically inactive gas, still, if we keep to the realism of science, we cannot deny its substantiality, and this requires a search for its chemical nature. My effort is no more than a tentative answer to this primary question, and its one object is to bring this question to the fore. — From Mendeléeff: "A Chemical Conception of the Ether," October, 1902, p. 51. Translated from the Russian (into English), by George Kamensky, A.R.S.M., of the Imperial Mint, St. Petersburg. Longman, Green and Co., 1904.

In 1926, thus 24 years later, this thought of the famous Russian chemist, to whom we are indebted for a table of the chemical elements, finds an echo in a statement by Sir J. J. Thomson, *Nature*, September 4, 1926, pp. 342-345: "*The Mechanism of the Electric Field*," in which he suggests the supposition of "*the existence in the universe of a structure*" which he "*for heuristic purposes*" compares with a "*subatomic and sub-electronic gas the particles of which are much finer than the electron.*"

This demand for a chemical, or at any rate logical, or at any rate substantial and understandable, ether has perhaps never been so strong as now; the most extensive use is now made of the properties of the ether. Statements by Signor Marconi also point to this.

As far as we are concerned we have right from the beginning worked with a chemical or at least understandable ether in virtue of the plan of our work. We borrowed our conception of the ether directly from empirical observation on fundamental properties of matter and logical deductions therefrom. The ether *must* consist in a *discontinuous manner of small particles*, otherwise no motion is possible; in this we find support in the striking analogy between sound and light.

But how does Mendeléef conceive the ether?

What do we understand by ether?

In his "*Dictionnaire Complet,*" P. Larousse defines the ether as "an imponderable elastic fluid, filling space and forming the source of light, heat, electricity, etc." This is laconic but sufficient to raise some misgivings in the mind of a thoughtful man of science. He is obliged to admit, in the ether, the properties of a substance (fluid), while at the same time, in order to explain in some way the transmission of energy through space by its motion, the ether is assumed to be an all-pervading 'medium.'" (Mendeléeff, *loc. cit.*, p. 1.)

We now take another encyclopedia which shows directly how the ether has been drafted since Mendeléeff's discussion. We find under "Aether" in "Winkler Prins-Geïllustreerde Encyclopedie," ed. 1905, Contributors on chemistry and physics, Prof. Dr. J. H. van't Hoff (!), Prof. Dr. M. de Haas and J. F. van Oss;—For the explanation of the phenomena of heat radiation, light and electricity, it has been found necessary to assume the existence of an extremely fine elastic substance which is spread throughout the whole world and fills all space which is not occupied by matter, thus, for example, also the space in between the atoms and molecules of all substances; this substance is called "ether." Ether was previously considered to be imponderable. It has been found from the energy of light waves that the ether is approximately 1.5×10^{19} times as light as the air (see Light and Electricity).

Very recently Mendeléeff attempted to give a chemical idea of the ether of space and indeed on the basis of the periodic system of the chemical elements and the interpolation method for the prediction of new elements, which has been applied with good results in working out this system.

From the discovery of the rare gases occurring in the atmosphere, which are from the chemical point of view quite inert and which were added by him to the periodic system as Group O, Mendeléeff deduced by extrapolation the existence of a zero series in the system of the elements. The element which would occur in the Group O of the series O, he calls *Newtonium* or the *light ether* and relates the following with regard to its probable properties; it is an inert gas, the atoms of which have a velocity of more than 2250 kms. per sec. and weigh about a millionth part of a hydrogen atom. As a result of the extremely small mass and the great velocity of the atoms, the ether element can within certain limits move freely in space. Nevertheless a considerable accumulation occurs around the sun and the fixed stars; the great extent of radiant energy in these stars is explained hereby. An accumulation of Newtonium around the atoms of highest atomic weight, such as uranium, thorium, and radium may contribute to an explanation of the radiating properties in these elements."

This is the main point. We shall return later in further contributions to the arguments by which Mendeléeff arrived at the existence of his ether and the properties thereof.

Here we only lay stress on the following: Mendeléeff distinguishes between matter and ether, but according to him both consist of particles and his conception of the ether is that of a fine, chemically inert *gas*. He thus assumes *complete discontinuity of matter*, which, however, is indeed nothing new for a chemist; whoever considers this point will acknowledge that the whole of our chemical thought is included in the symbol of discontinuity. This conception of discontinuity is purely chemical.

Whom have we to thank (?) then really for the illogical conception of the continuity of matter or at any rate of the ether? . . . a conception which is contrary to real experience and common sense? Does this come from the earliest days of physical thought, to which we also owe the strange conception of (supposed *real*) attractive or repulsive force (Empedocles's love and enmity)? Whose authority has caused this conception to last till our time? . . . . Aristoteles?

Bergen op Zoom,
Holland.
February, 1930.

BOARD OF TRADE ANNOUNCEMENT.

Dyestuffs (Import Regulation) Act, 1920.

Applications for Licences in January, 1930.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during January has been furnished to the Board of Trade b ythe Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month was 647, of which 572 were from merchants or importers. To these should be added 6 cases outstanding on the 31 December, 1929, making a total for the month of 653. These were dealt with as follows:—

Granted 611 (of which 594 were dealt with within 7 days of receipt).

Referred to British Makers of similar products—24. (All dealt with within 7 days of receipt.)

Outstanding on 31 January—18.

Of the total of 653 applications received, 618, or 95 per cent., were dealt with within 7 days of receipt.

ROYAL SOCIETY OF ARTS COMPETITION OF INDUSTRIAL DESIGNS.

Particulars of the Seventh Annual Open Competition of Industrial Designs to be held at the Imperial Institute, South Kensington, London, S.W., in June, 1930, have now been issued, and can be obtained from the Secretary of the Royal Society of Arts, John Street, Adelphi, London, W.C.2. Intending Competitors must apply to the Secretary of the Society between May 1 and May 10 for the necessary entry forms, the last day for receiving entries being May 26. The designs will be received at the Imperial College of Science and Technology, Imperial Institute Road, S.W., between June 11 and 13. In all scholarships and prizes amounting to nearly £1,900 are offered in connection with the 1930 Competition.

The Royal Society of Arts offers a prize of £25 for designs for the decoration and furnishing of a dining room in a small modern suburban house. and a prize of £20 for a set of Black and White Drawings of Architectural subjects. Three Scholarships will also be awarded; a Travelling Scholarship to the value of £100 in the Section of Architectural Decoration or Textiles offered by Mr. James H. Hyde; a Travelling Studentship of £75 offered by the Tootal Broadhurst Lee Company for designs suitable for Weaving or Printing intended for Dress or Furnishing Materials; and the Art Congress Studentship of £50 for practising craftsmen or designers, founded by the late Sir William Cuthbert Quilter.

Valuable Prizes ranging from £5 to £50 are also offered as under:—

In the Architectural Decoration Section for designs for a Metal Screen for a small Church; a Glazed Screen for a fashionable Hotel; an Anthracite Stove; Tile or Faience Surround for a Wood Mantel Opening; an Electric Light Fitting; and a Wooden Litany Desk.

In the Textile Section for designs for machine and hand block printed Cretonnes; printed Furnishings; printed Cotton Dress Cloths and light Ninon Fabrics; printed Silk Fabrics for Dress Wear; materiols for Ties for Men's Wear, Mufflers, Dressing Gowns and Linings for Ladies' Coats; Point-Stitch Tapestry; Tapestry or Moquette for Furniture Coverings; Wilton or Axminster Carpets and Jacquard Rug; printed Table Covers; embroidered Afternoon Tea Cloth; a piece of Embroidery; machine-made Lace Flounce and set of Laces for Ladies' Underwear; a knitted Frock and a knitted Jumper.

In the Furniture Section for designs for the furniture for a First Class Saloon Cabin for a Liner trading to the Far East; and the furniture and furnishings for a Modern Lounge.

In the Book Production Section for designs for a Title Page; pages of Text; line drawings for a Head and Tail Piece; Book Illustration; Jacket; and Cover.

In the Pottery Section for models executed in Fired Pottery of a Morning Tea Set; an ornamental group of Figures, Animals or Birds for a narrow shelf or mantelpiece; and a Commemorative Plaque suitable as an award in the Pottery and Glass Section of the Royal Society of Arts Competition. In the Glass Section for designs for a Perfumery Bottle for high-class trade; and a Grape Fruit Glass.

In the Advertising Section for designs for Posters, Showcards and Lorry Bills to advertise the following: the Illuminations of a Seaside Resort; a Line of Steamships to Australia and a Line of Steamships to the U.S.A. and Canada; an Insurance Institution; fast-dyed Cotton goods; Artificial Silk Fabrics, Lingerie or Hosiery; Stout, Potted Fish Paste; Chocolate; Jam; Loudspeakers; All-Electric Wireless Sets and Supply Units; Pneumatic Tyres for passenger and commercial vehicles; an Electric Wiring System; the use of Electricity in rural districts; the advantages of Poster Publicity; as well as for designs for a Box Top and Side Labels for Biscuits; a symbol for a Trade Mark; Christmas Greeting Cards and Calendars; covers for a monthly Food List and Furniture Sale Catalogue; and Decorative Leatherwork suitable for Blotters, Handbags, Pochettes, Bridgemarkers, etc.

The Royal Society of Arts was founded in 1754 for " The Engouragement of the Arts, Manufactures and Commerce of the Country " and it is interesting to remember that it was this Society's offer of Prizes in 1846 for " useful objects calculated to improve general taste " which led to the holding of the Great Exhibition of 1851 and to the commencement of the present school of Art-Workmanship in the British Empire.

Among the forthcoming books announced by the *Cambridge University Press* are " Surface Chemistry," by Dr. E. K. Rideal, " Band Spectra and Molecular Structure," by Prof. R. de L. Kronig, and " Plant Biology," by Dr. H. Godwin.

BRITISH INDUSTRIES FAIR. CHEMICAL SECTION.

MESSRS. THE GENERAL CHEMICAL & PHARMACEUTICAL CO., LTD.

Stand No. B.77.

The General Chemical and Pharmaceutical Co., Ltd., of Willesden, are exhibiting examples of " 'Judex " Analytical Aeagents, each one of which is guaranteed to conform to the recognised English standards; the firm's catalogue contains the fullest English list of Analytical Reagents A.R. yet published, and will be sent to bona fide enquirers applying on their trade letter paper. The catalogue contains, in addition to the general list, special lists wherein are grouped for easy reference the chemicals most usually required by the research departments of particular industries, as for example, the iron and steel industries.

Interesting examples of reagents which are of growing importance and are now prepared in a specially purified form are :—

" Judex " Nitroso-B-Naphthol for cobalt determination.

" Judex " D-Benzil Dioxime for the determination of various metals.

" Judex " Dihydroxytartaric Acid for the determination of sodium.

" Judex " Aluminon for the determination of alumininm.

Various " Judex " Indicators such a Thymol Phthalein and Cresol Phthalein.

The General Chemical and Pharmaceutical Company are at all times prepared t consider the manufacture even in smal quantities of the less usual chemicals required for research work, and correspondence to this end is welcomed. this polic has resulted in the successful manufactur of a number of research chemicals, which as far as information is available, have no previously been manufactured within th Empire.

A number of the Company's " Vulcan " Chemicals, for electro-plating and proces engraving, are also shewn, including a number of silver salts and of compound nick salts such as Nickel Potassium Cyanid Examples of Cadcium Sulphate, Cadmiu Cyanide and Chromium Trioxide are als exhibited, special interest attaching to thes chemicals owing to their increasing indu trial application.

The policy underlying the manufacture c " Vulcan " Plating Chemicals is based o the conviction that successful plating d mands not only chemicals of a high degr of purity but also that they should be

constant composition in order to ensure as far as possible uniform working conditions at all times.

In addition, there is an exhibit of "Oasis" Accumulator Acid, which, on account of its outstanding purity, is largely employed for storage battery purposes by the principal electric power stations, motor manufacturers and wireless telegraphic companies at home and abroad, as well as for aviation. The Company is in a position to offer attractive prices for export and pays special attention to export packing, having regard to the requirements of the shipping companies and to climatic and transport conditions overseas.

MESSRS. GRAESSER-MONSANTO CHEMICALS WORKS, LTD.
Stand No. A.134.

The Graesser-Monsanto Chemical Works Ltd., of London and North Wales, are again showing their well-known products in the form of phenol, salicylic acid, vanillin and saccharine.

Their phenol products include carbolic acid, ice crystals 40-41°C., Carbolic acid detacbed crystals 41° C., and carbolic acid liquefied crystals, together with cresylic acid and cresol derivatives. The Company claim to be the largest manufacturers of natural phenol in the world.

The salicylic acid will be shown as pure crystals of extreme whiteness, while the Vanillin-Monsanto appears as 100 per cent. pure crystals made from pure clove oil having its origin in selected cloves grown in Zanzibar. Saccharin-Monsanto is 550 times sweeter than sugar and its purity and uniformity is well known throughout the world.

A new product of this firm is methyl salicylate (oil of wintergreen) which is used to mask disagreeable odours in fly sprays, insecticides, mouth washes, perfumes, tooth pastes, embrocations, etc. The familiar aspirin is made in a special form for tablet makers (Aspirgran) which is ready for use without further treatment as it requires no granulation.

MESSRS. HOPKIN AND WILLIAMS, LTD.
Stand No. A.107.

Hopkin and Williams, Ltd., have been makers of Fine Chemicals in this country since the middle of last century and their products are well-known in the scientific world to those engaged in research work and general technical investigation.

A feature of their exhibit of A.R. chemicals is the inclusion of many reagents in the form of a crystalline powder—a great advantage from the practical point of view of the user.

Amongst organic reagents for analysis they are showing Dimethyl glyoxime, B-hydroxy-quinoline, Nitroso-B-Naphthol, Sulphanilic acid, etc.

Standard reagents for the preparation of buffer solutions for Hydrogen ion determination, are represented by Potassium Hydrogen Phthalate, Amino-acetic acid, Boric acid, Potassium Biphosphate, Sodium Phosphate, Potassium Chloride, etc., all in A.R. quality. Quinhydrone and calomel are shown in grades specially prepared for electrodes, and a representative collection of indicators for the colorimetric method. Standard sets of sealed buffer solutions containing the more generally used indicators are also shown, completing a comprehensive exhibit of chemicals for determinations of hydrogen ions.

Stains in solid form and compound stains in solution, covering all branches of microscopy form another section.

For geological research they are showing solutions for mineral separation, *i.e.*, Clerici solution, Cadmium Borotungstate, Methylene Iodide, etc.

A fine collection of radio-active Uranium bearing minerals and the products therefrom —Sodium Uranate, Uranium Nitrate and other salts, are shown.

The metallurgist will be interested in Sodium Bismuthate used in the estimation of Manganese.

The X-ray department is represented by an exhibit of Barium Sulphate for diagnosis.

Amongst tbe chemical and technical section, driers used by the paint and varnish manufacturers will be of interest ,such as Manganese Borate, Cobalt Acetate, etc.

In the optical section "Sira" Rouge made to the specification of the Scientific Instrument Research Association is shown.

OTHER TRADES AT THE FAIR.

Industries which serve industry are to be well represented in the London section of the British Industries Fair at Olympia, from February 17 to 28, and there should be good opportunities for business between one section of exhibitors and another—an aspect of the Fair which is apt to escape notice.

Exhibits of interest to exhibitors in all other sections are to be found, for instance, in the stationery and office appliance section, in the very much enlarged furniture section and in what is known as the general and sales services section.

FEATURES OF THE ARSENIC INDUSTRY.

Some of the Places Where It Is Produced in North America.

From A Special Correspondent.

The production of arsenic is almost world-wide. But the countries which produce it most generously are the United Kingdom, the United States, Mexico, Canada, Japan, Germany and France. While the output in 1929 has not yet been definitely ascertained, the year is estimated to have been a good one for the industry, at least in respect of quantity. In looking over the mineral results in Canada I find that the best producers were the Provinces of Ontario, British Columbia and Nova Scotia. Few mines exclusively producing arsenic are known, since it is of course obtained easily as a by-product in refining gold, silver, copper and lead.

In Ontario arsenic was for many years recovered from the gold ores of the Marmora district, Hastings County, in the south-eastern parts of the Province. When these mines were operating, however, the demand for arsenic was much less than in recent years, and the market price was correspondingly lower. In 1903 production ceased, after attaining a maximum of 800 tons of white arsenic in 1902.

About that time the production of arsenic from the Cobalt district in Northern Ontario began, and in 1906 201 tons of white arsenic were produced from ores from that district at a reduction plant at Copper Cliff. Following this the refining plant of the principal mine at Delora was completely remodelled for the treatment of silver-cobalt-arsenic ores and concentrates from the Cobalt district. This plant is now said to be the main source of arsenic production in the Dominion.

Largest Producers in the Empire.

Deposits of auriferous arsenopyrite are known in numerous localities throughout a belt extending for many miles eastward from Marmora in the townships immediately north of the main line of railway between Montreal and Toronto controlled by the C.P.R. It is possible that in the aggregate there is a large reserve of ore available, and that with recovery of the demand for arsenic many of the deposits could be profitably worked if a central plant were erected for the obtaining of both gold and arsenic.

Arsenical ores have been reported from a number of other districts in Ontario, particularly in the Sudbury and Algoma localities. A few years ago some shipments of arsenical gold concentrates were made from a mine at Howry Creek, sixty miles from Sudbury. Since 1903, however, practically the whole of the Dominion's output has come from mines in the Cobalt district, which is situate in the northern section of the Province, about one hundred miles northerly from North Bay.

The mines in that neighbourhood are essentially silver mines, though typical ore contains large quantities of arsenides. Similar conditions apply to the adjacent districts of Gowganda and South Lorraine. Ores from these mines have yielded an aggregate of about 2,000 tons annually for the past sixteen years. Canada has thus become the largest producer of arsenic in the British Empire. It also ranks second or third amongst the countries of the world as a source of this metal and its compounds.

Gold and Arsenic.

It is believed that many rich veins still remain to be discovered, and that the Cobalt region will continue for a long time to supply arsenic as well as silver and cobalt. The arsenical and cobalt concentrates from the Cobalt district are sent to a refining plant at Leloro in Southern Ontario, where the arsenic is recovered, mainly as the oxide—white arsenic.

Arsenopyrite is of common occurrence in Nova Scotia, being found as a constituent of the ore in practically all the gold mining districts of that Province. Mining has been carried on in some fifty different districts. These mines have been operated in the past solely as gold mines. Even when attempts have been made to concentrate the ore after amalgamation, the concentrates have been sold to the smelters for their gold value only.

Attention has recently been directed to the possibility of utilising these Nova Scotian deposits, and small shipments of arsenical concentrates have been sent to England and Germany, there being at present no plant in Nova Scotia for treating them. While in certain parts of the Province non-auriferous veins highly mineralised with arsenopyrite have been found, it is not believed that any of the known Nova Scotian deposits can be profitably operated for arsenic alone. The arsenic situation has, however, so improved in recent years that the recovery of the metal, or its oxide, as a by-product from the high gold ores in certain districts in Nova Scotia

should be both practicable and profitable. The production of arsenical concentrates was about 300 tons in 1927 in that province.

Treatment in Canada.

In British Columbia arsenical ores have been reported as occurring in a number of localities, both on the mainland and on Vancouver Island, among which is a prospect reported at Wolf Lake, near Comox. But, although some of the prospects are promising, no ore body of commercial size has yet been opened up. There is ,however, a recovery of arsenic from the ore of the Nickel Plate Mine at Hedley, about twenty miles north of the Canadian American boundary. The concentrates from this mine have all been sent, up to the present time up to Tacoma, Washington territory, for treatment.

In this connection it may be noted that there is a very strong feeling in Canada at the present time in favour of the treatment of arsenical ores in the Dominion, instead of the concentrates being shipped to the United States and Europe. Capital for such a plant is now said to be in sight, partly American and partly British. This is in line with the policy of keeping raw materials within the country, rather than sending them abroad for conversion into finished products.

MINERAL PRODUCTION IN NOVA SCOTIA, 1929.

Coal Mining.

The total output of the coal mines of Nova Scotia was 6,339,492 long tons (of 2,240 lbs.), of which 2,527,688 tons were shipped to the St. Lawrence market; 1,925,519 tons were used in Nova Scotia, apart from the quantities used at the collieries either in the mining plants or by the employees of the coal companies, amounting to 458,176 tons and 111,678 tons respectively. New Brunswick took during the period 688,572 tons; Prince Edward Island 106,227 tons; and Newfoundland 218,081 tons respectively. The outlook for winter employment is more promising than at the same time a year ago. Coal banked last winter has been cleared, and a considerable quantity is likely to be banked this season after the close of navigation. Fuel requirements of the Nova Scotia steel industry this winter are expected to be in excess of those last year. Much the greater part of Nova Scotia's coal output comes from Sydney coal field in Cape Breton Island, which is not only the largest in the Province but also the most highly developed and productive group of collieries in the Dominion.

GENERAL NOTES.

THE COMMERCIAL DIPLOMATIC SERVICE IN CHINA.

Resignation of Sir H. H. Fox, K.B.E., C.M.G.

It is notified by the Department of Overseas Trade that Sir H. H. Fox, K.B.E., C.M.G., F.R.G.S., has resigned his post as Commercial Counsellor at Peking, and retired on pension on the 1st January.

The Department wishes to place on record its appreciation of the valuable services rendered by Sir H. Fox during his career in China as a Commercial Diplomatic officer.

Sir H. Fox was appointed a Student Interpreter in China on 22 September, 18'0. He was promoted to Second Class Assistant in November, 1896; First Class Assistant in May, 1899, and Consul in June, 1905. After serving at various posts in China, he was promoted to be Consul-General at Chengtu in February, 1913. Sir H. Fox became Commercial Attache in China on 1 April, 1917, and received a fresh appointment as Commercial Counsellor on 1 April, 1918. He has served on various tariff commissions in China.

On Sir H. Fox's retirement it has been decided that the hearquarters of the Commercial Diplomatic Service in China shall in future be at Shanghai. Mr. H. J. Brett, C.M.G., will continue to serve at Shanghai and has been promoted to be Commercial Secretary, First Grade. Mr. Brett will be the senior Commercial Diplomatic Officer in China and will have the local rank of Commercial Counsellor. He is at present in England on official duty and leave and will return to his post later in the year.

The second post in China will be filled by Mr. A. H. George, who has been appointed Commercial Secretary, Second Grade, at Peking. Mr. George has already taken up his duties.

Mr. Brett was first appointed to China as Student Interpreter in March, 1901. After serving in various capacities in that country he was appointed Commercial Secretary at Peking in 1921. He was transferred to Shanghai in 1922.

Mr. George was appointed a Student Interpreter in China in 1908. He has served at various consular posts and has already undertaken the duties of Commercial Secretary for nine months in 1921-22 and for a similar period in 1925-26.

SOUTH AFRICAN FOOD, DRUGS AND DISINFECTANTS ACT.

The Department of Overseas Trade is now in receipt of a copy of the *Union of South African Government Gazette*, of December 27, containing the text of revised draft regulations issued under the above Act.

It is understood that considerable amendments have been introduced into these draft regulations since the publication of the previous draft. It is stated that it is intended to bring these rules into force on April 1.

A copy of the revised draft may be consulted at the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

SLUMP IN NEW CAPITAL ISSUES IN JANUARY.

Figures issued by the Midland Bank show issues of new capital in January to have totalled only £16.9 million, compared with £47.4 million and £33.79 million respectively in the first month of 1929 and 1928.

SHIPS LAUNCHED AND BUILDING IN 1929.

The United Kingdom contribute 54.5 per cent. of the tonnage launched throughout the world last year. Tonnage recently commenced more than replaces that launched, and, with the increased work in hand at the close of the year, the future of the shipping industry appears to be brighter than for some years.

BRITISH WHALING BOOM.

£677,000 Oil Production in Fifteen Weeks.

A catch of whales producing 162,500 barrels of oil, valued at over £677,000, is reported for the first fifteen weeks of the 1929-30 Antarctic season, ended February 2, by Anglo-Norwegian Holdings, Ltd., the largest British unit in the whaling industry, for the fleets it controls. This catch represents an increase of 28,450 barrels, valued at £118,540, as compared with the figures for the same period last year.

BRITISH INDUSTRIES FAIR.

Messrs. Donovan & Co., the electrical manufacturers and suppliers, of Cornwall Street, Birmingham, are exhibiting, among other goods, ironclad switchboards, open type switchboards, Home Office fuse and distribution boards, D.C. starters, regulators, etc. Among the exhibits of the firm a new type of isolating link will be exhibited for the first time.

BRITISH COLUMBIA MINING RESOURCES.

The British Columbia Chamber of Mines has received many inquiries concerning the minerals found in the Province of British Columbia. It has been considered advisable to issue a booklet, compiled from reliable sources, to show the various minerals and their uses. Accordingly, there has been listed 69 different minerals which cover almost every commercial use and which indicate that it might be possible to build up a large industrial development in British Columbia, provided capital is secured for the development of these minerals and the manufacture of their product.

To-day a few of them are manufactered in British Columbia, but the great majority are produced and the raw product shipped out of the country to be again returned in the manufactured state. Every effort should be made to manufacture the production of the mines in British Columbia, which would provide a great amount of employment, and create revenue to ferther develop the vast unexplored mineral areas.

The booklet seeks to show the great variety of minerals and the possibility for capital to establish industries. With hydroelectric possibilities and coal deposits scattered throughout the province, there is an assurance of cheap power. The mining laws are safe, and the government of to-day, as in the past, has always encouraged the development of legitimate mining operations in British Columbia.

CANADA IN 1930.

The High Commissioner of Canada in London has received from the Dominion Bureau of Statistics at Ottawa an interesting new publication entitled "Canada, 1930," containing in nineteen chapters a very great deal of information in concise form relative to the economic development of the Dominion at the present time.

The Handbook has been prepared with special care in order to meet the need which has been experienced both in Canada and in this country for a concise and up-to-date annual review, comprehensive in scope and popular in form, of the current economic situation in Canada, which would serve as a précis and compendium to the Canada Year Book and other official statistical publications which can be distributed only to the larger public libraries.

SPECIAL CHEMICALS FOR THE GOVERNMENT ASSAY OFFICE, EGYPT.

The Commercial Secretary to the Residency, Egypt, reports that the Egyptian Government Assay Office is calling for tenders, to be presented in Cairo by the 1 March, 1930, for the supply of "special chemicals for assay purposes."

Firms desirous of offering chemicals of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X. 6122 should be quoted.

NORTHERN ONTARIO (CANADA) MINERAL DEVELOPMENT.

In a recent address by the Hon. Charles McCrea, Minister of Mines of Ontario, the Minister referred to the fact that the value of the mineral output of the Province in 1929 had reached $110,000,000, and predicted that this figure would reach $200,000,000 within five years. During the next ten years he thought that the total output would be equal to the entire production during the past thirty years.

GOLD MILLING IN CANADA.

The Canadian Mining and Metallurgical Bulletin for January, 1930, just received at the Library of the Canadian Building, Trafalgar Square, London, S.W.1., contains the text of a paper on "Gold Milling in Canada," prepared by Mr. J. J. Denny for discussion at the Annual General Meeting to be held at Toronto in March by the Canadian Institute of Mining and Metallurgy. The paper is also to be presented at a Session of the Third Empire Mining and Metallurgical Congress in South Africa in March and April. Mr. Denny is metallurgical engineer to the McIntyre Porcupine Mines, Ltd., at Schumacher, Ontario.

The South Metropolitan Gas Company in 1929 earned £570,609, which compares with £561,799. A transfer of £80,000 to Special Purposes Fund is proposed, and the dividend for the year, as already announced, is again 6¼ per cent. for the third year in succession. A resolution to authorise the issue of new capital as and when required will be submitted as and when required will be submitted at the annual meeting. The Ordinary stock is quoted at 101¾.

CANADA REGAINS WORLD'S WHEAT CHAMPIONSHIP.

At the International Live Stock Exhibition and Hay and Grain Show at Chicago in December, 1929, Canada again carried off the wheat championship of the world. This honour went to Mr. Joseph H. B. Smith, of Wolf Creek, 140 miles west of Edmonton, Alberta. Thirteen other championships and reserve championships in live stock, hay and grain were won by Canadians this year. During the nineteen years that this exhibition has been held, Canadian farmers have won the wheat championship fifteen times. Ten times the award has gone to Saskatchewan, four times to Alberta, and once to Manitoba.

ICELAND PARLIAMENT'S MILLENNIAL CELEBRATIONS.

The Department of Overseas Trade have received from H.M. Consul-General at Reykjavik copies of pamphlets which have been issued in connection with the millennial celebrations of the Icelandic "Althing" in June next.

Various festivities are to take place, and special trips to Iceland have been arranged from Leith, Hull, Hamburg, Copenhagen and Bergen.

Copies of the pamphlets concerned may be obtained from the Department of Overseas Trade (Scandinavian Section), 35, Old Queen Street, London, S.W.1. (Reference 24550/1929.)

LOWER BANK RATE.

The reduction in Bank rate to 4½ per cent. came as a fitting ending to a year of financial difficulty and dear money. The rate was raised from 4½ on February 7, 1929, and after touching 6½ per cent. for five weeks returned to 4½ per cent. again on February 6, 1930. The reduction was not unexpected. Since the collapse of the American stock market boom, money has tended to cheapen in all the principal centres and official levels have been reduced. During the week prior to the reduction here, France came down from 3½ to 3 per cent., and Germany from 6½ to 6 per cent., while the Federal Reserve Bank of New York immediately followed the Bank of England by lowering its rate from 4½ to 4 per cent.

PROBABILITY AND CRITICAL POTENTIALS FOR THE FORMATION OF MULTIPLY CHARGED IONS IN MERCURY VAPOUR BY ELECTRON IMPACT.

By WALTER BLEAKNEY.

(*Physical Laboratory, University of Minnesota.*)

With a type of apparatus previously reported the procedure is described for measuring the probability of the formation of multiply charged ions in mercury vapour as a function of the velocity of the incident electron.

Critical potentials for the formation of multiply charged ions. New results together with those of an earlier paper place the minimum or ionizing potentials for the formation of Hg^+, Hg^{2+}, Hg^{3+}, Hg^{4+}, and Hg^{5+} by a single impact at 10.4, 30, 71, 143, and 225 volts respectively. A brief correlation of these results with those of other observers is given.

Relative numbers of multiply charged ions. A set of curves is given showing the fraction of the total positive ion current carried by each type of ion as a function of the electron velocity. Another set of curves shows the fraction of the total number of ions carrying one, two, three, four and five charges. The fraction for Hg^+ drops to a nearly constant value of 78 per cent. while the value for Hg^{2+} approaches 16 per cent. of the total number beyond 150 volts. At 400 volts the values for the five ions in order are 77, 16.5, 4.4, 1.3 and 0.8 per cent. respectively.

Quantitative measure of the number of ions produced and evective cross sectional area of the Hg atom. Curves are given representing the number, N, of each type of ion, per electron, per cm path, per mm pressure at 0°C. as a function of the electron velocity. The values of N for Hg^+, Hg^{2+}, Hg^{3+}, and Hg^{4+} have maxima of 20.8, 3.2, 0.72, 0.15 at 50, 115, 210, and 400 volts respectively. The effective cross-sectional area of the Hg atom toward an ionising collision of a given type is obtained by dividing the appropriate value of N by the number of molecules per cc. The maximum value of this area for Hg^+ is about 60 per cent. of the kinetic theory value.

A discussion is given of the meaning of the area under the peaks in the e/m analysis curves and its effect on the accuracy of the interpretation of the data. — *Physical Review.*

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, February 6, 1930.

The following papers were read :—

The Behaviour of a Single Crystal of Antimony Subjected to Alternating Torsional Stresses. By H. J. GOUGH AND H. L. COX. Communicated by Sir Thomas Stanton, F.R.S.

The Theory of Metallic Corrosion in the Light of Quantitative Measurements. III. By G. D. BENGOUGH, J. M. STUART AND A. R. LEE. Communicated by Sir Harold Carpenter, F.R.S.

Measurement of Absorbing Power of Materials by the Stationary Wave Method. By A. H. DAVIS AND E. J. EVANS. Communicated by Sir Joseph Petavel, F.R.S.

The paper describes an apparatus set up for determining the acoustical absorption coefficient of small samples of material for sound, incident perpendicularly; discusses the theory of the method and of its corrections; and gives a detailed examination of the performance of the apparatus. Presenting a large number of varied experimental results the paper discusses factors which may affect them and gives a theoretical basis for certain novel effects, due to varying the thickness of an absorbent or its distance from a backing wall.

In conclusion, stationary wave coefficients for certain practical materials are compared with coefficients obtained by a " reverberation " method, in which random incidence of sound is employed.

The following papers were read in title only :—

The Equations of the Quantum Theory. By J. W. FISHER AND H. T. FLINT. Communicated by O. W. Richardson, F.R.S.

These equations are obtained by analogy with Maxwell's equations applied to empty space. They are expressed by means of a five-dimensional system of co-ordinates with the adoption of a metric after the manner of Weyl and Eddington in four-dimensions. It is shown that no arbitrary introduction of operators is necessary to obtain Dirac's equations.

The quantum problem is shown to be a radiation problem in five-dimensions, and the equations proposed are invariant. Quantum phenomena are regarded as suggesting the metric which is to be applied to space,

The Effect of Nuclear Spin on the Optical Spectra. II. By J. HARGREAVES. Communicated by R. H. Fowler, F.R.S.

The paper contains a general method for dealing with the effect of a nuclear spin of possibly more than half a quantum, by the use of multiple wave functions, as introduced by Pauli and Darwin, and is applied in detail to the cases of a nuclear spin of 1, $1\frac{1}{2}$ and $4\frac{1}{2}$ quanta respectively. Results are obtained which are in exact agreement with a general formula given by Hill, since the present work was carried out, and there is good qualitative agreement in the case of a spin of $4\frac{1}{2}$ quanta with the observations of Back and Goudsmidt for Bismuth. In the present paper the interaction energy of the nucleus and electron spins is neglected, without effect on the kinematical problem of determining the multiplet intensities.

Characteristic Energy Losses of Electrons Scattered from Incandescent Solids. By E. RUDBERG. Communicated by O. W. Richardson, F.R.S.

The velocity distribution of an initially homogeneous beam of electrons after scattering from a solid target kept at incandescence, has been studied by means of a magnetic deflexion apparatus. The usual focussing arrangement was adopted, the path of the electrons being determined by three slits in fixed position. The velocity spectrum is obtained either by varying the magnetic field or, while keeeping this constant, by adding measured amounts of kinetic energy to the scattered electrons by an applied accelerating electric field. The curves show a sharp peak due to reflected electrons and several small maxima for slightly lower values of the energy. These maxima are characteristic of the substance forming the target; their positions with respect to the reflected peak remain constant for a wide range of bombarding voltages.

Using a modified form of the apparatus, in which target and electron gun can be rotated, it is proved that these maxima are also independent of angle of scattering. Tables are given for positions of such maxima, from measurements with different targets. The experimental results, as to behaviour of these maxima, indicate that they should be associated with occurrence of inelastic collisions with the target atoms, involving definite energy changes, such as excitation and ionisation.

Continuous Absorption. By J. A. GAUNT. Communicated by R. H. Fowler, F.R.S.

This paper investigates afresh the problem of the rate of absorption of light by electrons which are initially bound to a nucleus, or free and "colliding" with a nucleus, and after absorption are free in either case. Such a process gives rise to a continuous absorption spectrum and is believed to be the main source of the general opacity in stellar atmospheres and interiors. The problem has been treated in a classical way by Kramers (whose formulæ have hitherto been generally used by astrophysicists) and more recently by Oppenheimer and Sugiura.

The interest and difficulty of the problem lie in the effective evaluation of the formal quantum theoretical expression for the absorption coefficient. The paper makes advances in this, showing that Kramers' classical formula is asymptotically correct in the region in which one would expect it to be so by the correspondence principle. Deviations of the exact formula from Kramers' are evaluated asymptotically in different regions. The deviations of astrophysical significance are found. A mistaken location of such deviations by Oppenheimer is detected. It appears probable that the discrepancy between the requirements of Eddington's stellar theory and Kramers' formula is retained by the quantum theory of continuous absorption.

Correction Factors in Photographic Measurement of X-Ray Intensities in Crystal Analysis. By E. G. COX AND W. F. B. SHAW. Communicated by Sir William Bragg, F.R.S.

Some Solutions of Einstein's Gravitational Equations for Systems with Axial Symmetry. By W. R. ANDRESS. Communicated by A. S. Eddington, F.R.S.

THE CHEMICAL SOCIETY.

Thursday, February 6.

The Photolysis of Aqueous Hydrogen Peroxide Solutions. Part I. Methods. Part II. Results. By A. J. ALLMAND AND D. W. G. STYLE.

The following matters were discussed: (i) the specimens of hydrogen peroxide used, (ii) the determination of extinction coefficients, (iii) the type of reaction cell used and the method of experimentation (this involved pumping off the oxygen formed in the reaction and measuring it, a procedure which allowed of the use of concentrated hydrogen peroxide solutions), (iv) the light sources and light filters used, (v) the methods employed to measure the absorbed energy, to vary the intensity, the time of insolation, the concentration and the temperature, (vi) the modified technique used in a few experiments with dilute solutions.

II.—The effects of variation of intensity, wave-length, concentration, duration of insolation and temperature when using Merck's perhydrol are described. The effects of the same factors when using hydrogen peroxide prepared in the laboratory are described. Experiments with dilute solutions are described. It is found that (i) the velocity varies with the square root of the light intensity, (ii) the velocity diminishes with increase in concentration, (iii) the quantum efficiency diminishes with increase in the frequency of the light. Attention is directed to the similarity between the photochemical and thermal reactions, to the effect of dust particles, to the significance of the temperature coefficiens, to the undoubtedly very long reaction chains, to the probable nature of the primary light action and of the "catalyst" produced by it. The most satisfactory of the many hypotheses which have been examined is very briefly sketched; it is realised that a more detailed theoretical treatment is not yet justified.

The Scission of Diaryl Ethers and Related Compounds by Means of Piperidine. Part III. The Nitration of 2 : 4-dibromo-2′ : 4′-dinitrodiphenyl ether and of 2 : 4-dibromophenyl p-*toluenesulphonate and benzoate. The Chlorination and Bromination of* m-*nitrophenol.* By Miss R. V. Henley and E. E. Turner.

Mononitration of 2 : 4-dibromo-2′ : 4′-dinitrodiphenyl ether gives 2 : 4-dibromo-5 : 2′ : 4′-trinitrodiphenyl ether, scission of which with piperidine gives 2 : 4-dinitrophenylpiperidine and 2 : 4-dibromo-5-nitrophenol. The nature of two dibromonitrophenols described in the literature is discussed.

Monochlorination of *m*-nitrophenol occurs in the 2- and 4-positions, dichlorination giving the 2 : 4-compound. Monobromination of *m*-nitrophenol gives 4-bromo-3-nitrophenol under certain conditions, and the 6-bromo-isomeride under other conditions. The results obtained render necessary a revision of the constitutions hitherto assigned to certain halogen derivatives of *m*-nitrophenol.

Trypanocidal Action and Chemical Constitution. Part IX. Aromatic Arsinic Acids Containing an Amide Group. By G. A. C. Gough and H. King.

Dunning and Reid showed that a series of dyes produced by coupling diazotized *p*-aminophenylstibinic acid with naphthylaminesulphonic acids were trypanocidally active. An unsuccessful attempt was made to prepare colourless analogues of these possessing trypanocidal activity. In searching for some explanation of the lack of activity of such colourless products it was found that benzamide-*p*-arsinic acid had a chemotherapeutic index more favourable than that of atoxyl, the starting point of Ehrlich's series of arsenicals. As this was the first benzamidearsinic acid to be described, a wide field was opened for development. A large number of substituted benzamidearsinic acids have now been prepared, and from a consideration of the constitution and trypanocidal activity of these certain general conclusions are reached.

The Action of Phenyldiazonium Chloride on 2-nitroethanol and its Derivatives. By E. C. S. Jones and J. Kenner.

The behaviour of 2-nitroethanol and a number of its derivatives towards phenyldiazonium chloride is described. Compounds of the type $XCH(OH).CH_2.NO_2$ may be converted successively into $X.CH(OH).C(:N.NH.Ph)NO_2$ and nitroformazyl, the latter being accompanied by the aldehyde $X.CH(OH).CHY.NO_2$ also furnish the aldehyde X.CHO, and the hydrazone $PhNH.N:CY.NO_2$.

Reference is also made to the relationship of these changes to the reversal of the aldol and the Michael reactions.

GEOLOGICAL SOCIETY OF LONDON.

January 22, 1930.

The following communications were read:

On the Geological Collection from the South Central Sahara made by Mr. Francis Rodd. By Prof. John Walter Gregory, LL.D., D.Sc., F.R.S., Pres.G.S.; Ethel Dobbie Currie, Ph.D., B.Sc., F.G.S.; J. Weir, M.A., Ph.D.; S. Williams, M.Sc., Ph.D.; and George Walter Tyrrell, Ph.D., F.R.S.E., F.G.S.

The Aïr Massif in the South Central Sahara was shown by the work of Barth (1857) and Chudeau (1907, etc.) to consist of a foundation of gneiss, schist, and granite, on which rest in the north and west sheets of Devonian marine beds, and in the south Cretaceous limestones and subaërial sandstones. Mr. Rodd's collection adds much to our knowledge of the area.

The gneiss and schists have been called Silurian, but are probably pre-palæozoic. Mr. Rodd's collection contains ancient gneisses and schists, and granites, with pegmatites and highly-kaolinized rocks. Mr. Rodd has found at InNuguren, west of the Aïr Massif, well-preserved Turonian fossils, and among them Dr. Weir identifies

Exogyra olisiponensis, which occurs in Angola, Tunis, Portugal, and Mexico, and, with the other fossils, affords evidence of a connexion of the sea in Angola with that of the Mediterranean across the Central Sahara. Some terrestrial deposits earlier than the Turonian limestones contain silicified fossil wood, which Dr. Williams has identified as *Dadoxylon* and as resembling the Upper Cretaceous *D. dantzii* of Tanganyika Territory. Dr. Williams's investigation of this material shows that *Dadoxylon* wood may be of stratifigrphical value.

The igneous rocks collected are identified by Dr. Tyrrell as including basanite and phonolitoid ægirinetrachyte, and represent a northern extension of the Kainozoic volcanic series of Kenya and Kordofan.

It has been held that the Cretaceous limestones of the Sahara were part of a series that extended east and west in a depression parallel to the Mediterranean, and connected with the Gulf of Aden. Mr. Rodd's collection indicates that the Central Sahara was partly submerged by a Turonian transgression, which connected the Angola Gulf and the Lower Niger with Tunisia. It had a branch westward through In Nuguren towards the Middle Niger, but had no known connection across Abyssinia with Somaliland or the Gulf of Aden.

The Geology of Some Salt-Plugs in Laristan (Southern Persia). By JOHN VERNON HARRISON, B.Sc., F.G.S.

The area under consideration is contained in tht rectangle between lat. 27° and lat. 28° 20′ N. (85 miles) and between long. 54° 20′ and long. 57° E. (175 files). The two main towns are Bandar Abbas and Lar.

Much of this district is covered by normally folded rocks which range in age from Ordovician to Recent, and reach an aggregate thickness of as much as 25,000 feet. The lowest 1,000 feet are chiefly shales and sandstones. From Carboniferous to Middle Miocene there are about 18,000 feet of strata which are mainly limestones. The silt, sand, and conglomerate of the Mio-Pliocene together reach a thickness of 11,000 feet. The only general angular unconformity occurs high in the Mio-Pliocene. On the north and east the frontal part of the nappes overrides and ploughs into the normally folded rocks.

South and west of the line of nappes the normal folds have been invaded by plugs of salt, which have brought up quantities of gypsum and blocks of sedimentary and igneous rocks. The extrusive salt has come to the surface at different times, from Oligocene to late Mio-pliocene. The intrusive salt-masses, sheathed with autochthonous sediments tilted around them, form, in some cases, brightly coloured mountains of very striking and characteristic appearance.

Where the sedimentary sheath has been broken or removed by erosion, tongue-like masses of salt and gypsum have moved outwards from the salt dome, and these are described as salt-gypsum 'glaciers.' Erosion has sometimes entirely removed the soluble upper portions of a salt-plug and left a corrie-like valley in a limestone hogback. In such a case the corrie-floor is covered with a layer of the insoluble material which has accompanied the salt to the surface.

This jumbled assemblage of rocks is designated the Hormuz Series. They comprise fœtid dolomites, and limestones, dark calcareous shales, red sandstone and shale, variegated shales and sandstones, and igneous rocks which range from granite-porphyry to basalt, all more or less epidotized. Dr. G. M. Lees first found Cambrian trilobites in the dark shales, and since then other geologists have discovered them in several other localities. The Hormuz Beds are believed to lie directly on the salt which has brought them to the surface, so that the salt and gypsum of the salt-plugs must be older than Middle Cambrian.

The formation of the salt-plugs is attributed to tangential forces acting on Cambrian salt, which, on account of its comparative elasticity, has acted as something analogous to an igneous magma in its behaviour.

THERMAL PROPERTIES OF PETROLEUM PRODUCTS.

By C. S. CRAGOE.
(*U.S. Bureau of Standards.*)

(ABSTRACT.)

Various thermal properties of petroleum products are given in numerous tables which embody the results of a critical study of the data in the literature, together with unpublished data obtained at the Bureau of Standards. The tables contain what appear to be the most reliable values at present available. The experimental basis for each table, and the agreement of the tabulated values with experimental results, are given. Accompanying each table is a statement regarding the estimated accuracy of the data and a practical example of the use of the data. The tables have been prepared in forms convenient for use in engineering.

NOTICES OF BOOKS.

The Soya Bean and the New Soya Flour. By C. J. FERREE. (Revised and translated from the Dutch by C. J. FERREE AND J. T. TUSSAUD. Pp. xii + 80. London: Wm. Heinemann (Medical Books) Ltd., 99, Great Russell Street, W.C. 1930. Price 6s.

The soya bean, a leguminous plant named botanically *Glycine hispida*, will soon assume consierable importance on account of the value of its oil and its flour. The oil is already used in ever-increasing quantities in the margarine and other industries, whilst the flour, rich in vitamines and of high food value, is destined for greater consumption as a foodstuff. It has for centuries formed one of the staple foods in China and Japan. It is unusually nutritious for it has high percentages of fats and proteins, the latter closely resembling milk casein in general chemical properties.

The present authoritative volume (with a foreword by Sir Wm. Arbuthnot Lane) is therefore most opportune, for it gives a complete account of the cultivation, harvesting, production costs and yields, the general ingredients, value and uses of the bean.

The author predicts an increase in the areas under cultivation, and an extension of the use and consumption of the oil and flour in western countries and in America where the plant is already grown. The book is profusely illustrated and the author has drawn upon the already extensive literature of the plant and its products so that it is deserving of the attention not only of chemists and biochemists, but also of agriculturists and industrialists.

The Conductivity of Solutions. By CECIL W. DAVIES. Pp. viii + 204. London: Chapman & Hall. 1930. Price 15s.

The theory of the dissociation of electrolytes in solution was first advanced over 40 years ago by Arrhenius. Its great limitation was that the salts and other strong electrolytes do not show quantitative agreement with the theory he put forward. An explanation of this anomaly has now been found in the theory of inter-ionic attraction which has gained general acceptance, especially since the recent work of Debye and others.

The author of the present volume on the conductivity of solutions has endeavoured to show how the latest work supplements rather than replaces the earlier views of Arrhenius. The early chapters deal with the methods and results obtained in conductivity measurements whilst the second half of the book is concerned with the applications of these results in analysis and in supplementing other physico-chemical determinations.

On the title-page we are reminded by the two dates 1830 : 1930 that this is the centenary year of Messrs. Chapman and Hall's publishing business. Mankind owes them, in common with others, a debt of gratitude for propagating scientific knowledge for it must be seldom that a chemical treatise is a "best seller." Mr. Davies' book should be read by all physical chemists interested in conductivity work and in the modern views on electrolytic dissociation.

Trade Marks Simplified. By H. J. W. WILDBORE. Pp. 113. London: Jeffcoats, Ltd., 3, Church Passage, New Compton Street, W.C.2. 1930. Price 10s. 6d.

This book is written with commendable lucidity and would make the ins and outs of trade mark registration clear to anyone without the smallest technical knowledge of the subject. It may be fairly hazarded that only a very small proportion of manufacturers and merchants know anything at all about Trade Mark registration, beyond the fact that a mark can, under certain conditions, be registered; and yet the importance of the subject, to all who make or sell goods, is considerable. Modern tendencies with widespread advertising, are giving to distinctive marks a value greater than ever before, and information of the kind given by Mr. Wildbore ought to form part of the knowledge possessed by any business man to whom trade marks can be of importance.

The ground covered by the book seems very extensive and information on every detail of registration is, apparently given in its pages. A word of commendation should be added, of the judicious arrangement of the book, which makes it easy to turn up information on any desired aspect of the subject.

A further noticeable feature is the paragraphs given to specific trades, dealing with trade mark points specially applicable to the industry concerned and also the valuable help and guidance afforded to those concerned in Export Trade.

Forthcoming Events.

ROYAL SOCIETY OF ARTS.

Monday, February 17, at 8 p.m.—(Cantor Lecture.) Alfred B. Searle: "Recent Improvements in Methods of Brickmaking." (Lecture I.)

Wednesday, February 19, at 8 p.m.—(Ordinary Meeting.) "Alfred Stevens: Architect—Sculptor—Painter."

LECTURES ON TROPICAL HYGIENE.

The London School of Hygiene and Tropical Medicine (University of London) announce that their next course of lectures on tropical hygiene for men and women (outside the medical profession) proceeding to the tropics will be given daily on March 12 to 14 and 17 to 21, from 5.30 to 7 p.m. Enquiries regarding this and future courses should be addressed to the Secretary, Keppel Street, Gower Street, London, W.C.1.

ROYAL MICROSCOPICAL SOCIETY.

20, Hanover Square, London, W.1.

A Meeting of the Society will be held in the Lecture Hall at the above address on Wednesday, 19 February, at 7.30 for 8 p.m. The following papers will be read and discussed :—

" Early Achromatic Microscopes by James Smith." By Dr. Reginald S. Clay, B.A., D.Sc., F.Inst.P., F.Op.S., F.R.M.S., and Mr. Thomas H. Court.

(1) " Coincident Images made use of in Mycological and Bacteriological Works with Reference to Single Spore Cultures."

(2) " Reflection Magnification used for Physiological Experiments connected with Transpiration."

(3) " A Note on Illuminating Objects for Microscopical Examination." By Mr. D. V. Daran, B.A.

GEOGRAPHICAL SOCIETY OF LONDON.

The Annual General Meeting of the Society will take place on Friday, February 21, 1930, at 3 p.m. The Fellows and their friends will dine at the Connaught Rooms, Great Queen Street, W.C.2., on the same evening, at 7.15 for 7.30 p.m.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Tuesday, February 18, at 5.15 p.m.—" X-Ray Determination of the Structure of Cellulose." By Sir William Bragg, F.R.S.

Thursday, February 20, at 5.15 p.m.—" Architecture of Pre-Spanish America." By T. A. Joyce.

Friday, February 21, at 9 p.m.—"Principles of Plant Breeding." By J. B. S. Haldane.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

1,562.—Imperial Chemical Industries, Ltd.—Purification of mercaptobenzthiazole. January 16.

1,636.—Imperial Chemical Industries, Ltd., Higgins, C. L., and Barker, J. T.—Production of chlorine and hydrogen. January 17.

1,658.—Imperial Chemical Industries, Ltd., Sprent, W. C., and Bennett, N. — Preparation of monalkyl xylenesulphonamides. January 17.

1,684.—International Industrial & Chemical Co., Ltd.—Ammonia manufacture. January 17.

1,232.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges).—Manufacture of ethers of carbo-hydrates. January 13.

Specifications Published.

323,713.—Marks, A. H., and Russell, P. (legal representatives of Marks, E. C. R., deceased). (Du Pont de Nemours & Co., E. I.) — Catalytic processes of dehydrogenation and dehydration of organic compounds.

298,640.—I. G. Farbenindustrie Akt.-Ges. Process for the manufacture of dinaphthylene dioxide quinone.

323,806.—Carpmael A. (I. G. Farbenindustrie Akt.-Ges.) — Process for the manufacture of derivatives of dinaphthylene dioxide.

302,251.—I. G. Farbenindustrie Akt.-Ges. Manufacture of azo dyestuffs.

323,948.—Johnson, J. Y. (I. G. Farbenindustrie Akt.-Ges.) — Manufacture and production of nitriles.

Abstract Published.

322,281.—Dyes.—Johnson, J. Y., 47, Lincoln's Inn Fields, London. (I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.)

N - Dihydro - 1.2 : $2^1.1^1$ - *anthraquinone - azine series.*—The condensation products of N-dihydro-1.2 : $2^1.1^1$ - anthraquinoneazines with formaldehyde or agents supplying formaldehyde (Specification 20527/04) are

converted by oxidation into new dyestuffs which dye more greenish shades than the initial materials. Acid or alkaline oxidising agents may be used or the initial material may be heated with alkaline agents alone whereby a leuco compound of the new dyestuff is formed which is then oxidised. The preparation of the starting material and the subsequent oxidation can be carried out in one operation. In examples, (1) the condensation product of N-dihydro-1.2 : $2^1.1^1$-anthraquinoneazine and paraformaldehyde is oxidised in sulphuric acid solution with potassium bichromate; (2) the condensation product of N-dihydro-1.2 : $2^1.1^1$-anthraquinoneazine and formaldehyde is heated with ground caustic potash and the product air oxidised; (3) a suspension of N-dihydro-1.2 : $2^1.1^1$-anthraquinoneazine in sulphuric acid is treated with paraformaldehyde and the condensation product, with or without isolation, oxidised with manganese dioxide.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ESTHETA.

507,545.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research and anticorrosives.—Paul Peter Mulhens, trading as Eau de Cologne & Parfumerie-Fabrik, "Glockengasse No. 4711," Gegenuber der Pferdepost von Ferd, Mulhens, 26, Glockengasse, Koln am Rhein, Germany. January 22.

505,590.—A label device with diamond in the centre. All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research, and anticorrosives.—Berry, Wiggins & Co., Ltd., Tensulam House, Water Lane, Stratford, London, E.15. January 22.

NOSILLA.

508,358.—Photographic plates and chemicals.—Morris Allison & Co., 155, Victoria Street, London, S.W.1. January 22.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

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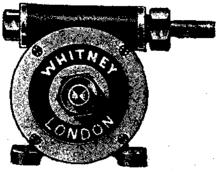

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THE ROYAL SOCIETY.

Government Grant for Scientific Investigations.

Applications for the year 1930 must be received at the Offices of the Royal Society not later than MARCH 31ST Next, and must be made on Printed Forms to be obtained from the Clerk to the Government Grant Committee, Royal Society, Burlington House, London, W.1.

NOTICE TO AUTHORS AND CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

A PIPETTE METHOD OF MECHANICAL ANALYSIS OF SOILS BASED ON IMPROVED DISPERSION PROCEDURE.

By L. B. Olmstead, Lyle T. Alexander, and H. E. Middleton, *Division of Soil Chemistry and Physics, Soil Investigations, Bureau of Chemistry and Soils, U.S. Department of Agriculture.*

In all methods of mechanical soil analysis some separations are based on the well-known fact that the smaller particles in water suspensions fall more slowly than larger ones. In elutriation methods the smaller particles are borne upward by a rising water column while while larger particles fall. In the early work of the Bureau of Soils the Osborne beaker method was used to make silt and clay separations. Whitney apparently was the first to use the centrifuge to increase the settling velocities of soil particles. The centrifuge method was then worked out independently by Hopkins and Snyder. In 1904 the Bureau of Soils published its centrifuge method, which with modifications has been used until recently.

The centrifuge method was much more rapid than the beaker method and gave better dispersion than elutriation methods. In this method the silt and clay were separated from the sands by decantations from a shaking bottle, and the silt was separated from the clay by centrifuging. With trained men checking their silt and clay separations with a microscope micrometer, the analyses generally were reproducible. Dispersion was obtained by shaking a 5-gm. soil sample with 150 c.c. of distilled water containing 1 c.c. of concentrated ammonia. As many as 40 centrifugings were necessary in some cases to give a complete separation. In such cases, rubbing the wet sample with a rubber policeman hastened the operation. Later rubber balls with lead centres were put into the shaking bottles to assist in cleaning colloid coatings from sand grains and in breaking colloidal aggregates.

About 1919, when attempts were made to determine quantitatively the amount of colloid in soils, it was found that dispersion was not always so complete as had previously been believed. Davis and Middleton then studied a number of methods of dispersing soils preparatory to their separation by the centrifuge method. They concluded that some chemical assistance was necessary for complete dispersion and recommended treatment with 0.1 *N* HCl for one hour followed by washing in the centrifuge to remove excess acid and exchanged ions. The sample was then shaken seven hours in 0.05 *N* NaOH.

The introduction of the pipette method developed independently by Robinson in Wales, Krauss in Germany, and Jennings, Thomas, and Gardner in the United States, necessitated a more stable and more complete dispersion than was required in the centrifuge method. A study of dispersion was undertaken by the first commission (soil physics) of the International Society of Soil Science, that resulted in the adoption at the First International Soil Science Congress held in Washington in 1927, of two methods for mechanical soil analysis. One method, called the practical method, secured dispersion by shaking with ammonia, boiling, and rubbing. The other method, designed to secure complete dispersion, prescribed treatment with hydrogen peroxide to remove organic matter, treatment with 0.2 *N* HCl followed by washing to remove alkaline earth carbonates and adsorbed bases, and treatment with ammonia or sodium carbonate to secure dispersion. The latter method will be referred to hereafter as the international method. No attempt was made to fix the size classes, but an arbitrary relationship between sedimentation velocity and particle size was established.

These two methods, one intended to give partial and the other complete dispersion, represent two diverse purposes of mechanical analysis. In so-called practical methods such as the first the endeavour is made to avoid removing the coating from soil particles or breaking apart slightly cemented sand grains or aggregates of finer material which would not be resolved in tillage operations or under severe weather conditions in the field. Hilgard obects to the use of acids to disintegrate compound particles, particularly in calcareous sands. In practical methods it is difficult to determine just when a proper degree of dispersion has been reached. For example, Bouyoucos, in an effort to secure an analysis of the ultimate natural soil structure, does not give the sample as rigorous treatment as the international practical method proposes.

A mechanical analysis based on complete dispersion does not give so true a picture of field structure and associated physical properties as does the practical method, but it does give information more valuable for most purposes. It gives the amount of coarser material stripped of adhering material, the amount of colloid, and usually the approximate amount of organic matter. Since the colloid is the seat of most soil chemical reactions and governs or strongly influences most of the physical properties, the quantitative determination of the finest soil fraction is the most important single

determination in a mechanical analysis. In the case of concretions of irreversible colloidal material having adsorptive properties less than that of dispersed colloid but more than that of solid mineral grains, there is some question as to how far dispersion should be carried.

This article reports an investigation of methods of obtaining dispersion of soil material, with special reference to the effect of acid treatment and the use of alkaline dispersing agents. A method for the removal of organic matter from manganese soils is included. A procedure for mechanical soil analsyis, based on the most satisfactory of several methods of soil dispersion investigated, is here outlined. This is the method now used in the Bureau of Chemistry and Soils. This method is designed to secure complete dispersion of soil material below 2 mm. in diameter after organic matter and water-soluble material have been removed. Sieves are used to make all separations except those at 5μ and 2μ, where the pipette is used.

Dispersion.

Good dispersion is the key to accurate mechanical analysis. By complete dispersion is meant the remofal of colloid coatings on sand and silt grains and the separation of aggregates into single grains or groups smaller than 2 μ equivalent diameter. The problem of dispersion is (1) to obtain, and (2) to maintain suspensions free from aggregation. The chemical and mechanical aids to dispersion considered are treatment with (1) hydrogen peroxide, (2) hydrochloric acid, (3) water, and (4) dispersing agents, e.g., ammonium hydroxide, sodium hydroxide, sodium carbonate, and sodium oxalate, electrodialysis; and shaking.

Hydrogen Peroxide Treatment.

In the analysis of soils high in organic matter G. W. Robinson found that dispersion was aided by the removal of organic matter with hydrogen peroxide. He ascribes this effect to the removal of material which cements soil particles into aggregates strongly enough to resist ordinary dispersion methods. Although it is not necessary to remove organic matter in order to secure dispersion of the mineral portion of the soil, its presence interferes with the separation of the material into size classes. For this reason all samples for routine analysis in this laboratory are treated with 6 per cent. H_2O_2, in accordance with the international method.

When manganese dioxide is present in sufficient quantity it is not possible to remove the organic matter by the usual treatment. Since manganese dioxide is the only form of manganese which catalytically decomposes hydrogen peroxide so rapidly that the organic matter is very slowly attacked, the obvious remed yis to convert it into some other manganese compound. W. O. Robinson found that if a small fraction of 1 per cent. of manganese dioxide was present it could be destroyed by evaporating the sample with a very small excess of oxalic acid. In this investigation, if manganese dioxide was known to be present or its presence was indicated hy the violence of the reaction, acetic acid was added, followed by hydrogen peroxide, the purpose being to convert the manganese dioxide into the manganous form which does not interfere with the decomposition of organic matter by hydrogen peroxide.

The effect of acetic acid treatment was determined on duplicate samples of Wabash silt loam from Nebraska. The samples contained about 3 per cent. organic matter and 0.11 per cent. manganese, calculated as manganous oxide (MnO). The rate of decomposition of hydrogen peroxide indicated that the manganese is not in the form of manganese dioxide. To 10-gm. samples of this soil were added various amounts of finely precipitated manganese dioxide and acetic acid. The amount of carbon dioxide evolved decreased rapidly with the addition of manganese dioxide. The presence of 0.1 per cent. (10 mg.) of manganese dioxide did not interfere with the decomposition of organic matter when 10 mg. of acetic acid was used. Blanks run by treating acetic acid with hydrogen peroxide in the presence of manganese dioxide showed practically no evolution of CO_2 due to oxidation of the acid.

In some cases hydrogen peroxide decomposes the organic matter slowly and incompletely. In one case, recently noted, hydrogen peroxide attacked the organic matter only slightly. After the addition of 1 or 2 mg. of manganese dioxide the organic matter was quickly attacked and apparently completely decomposed.

Acid Treatment.

In the pipette method of mechanical analysis it is necessary to prepare soil suspensions in such manner that they may be kept in a sedimentation chamber for several days without coagulation into flocks larger than 2μ equivalent diameter. For this purpose treatment of the soil sample with hydrochloric acid has been found helpful

because it dissolves alkaline earth carbonates and removes "exchange bases" which later might cause flocculation of the suspension. There are, however, some objections to the use of acid treatment.

In the international method the soil, after decomposition of organic matter, is treated with enough hydrochloric acid to decompose the carbonates and still leave 250 c.c. of solution of 0.2 *N* HCl. Such rigorous treatment dissolves sesquioxides of iron and aluminium and some silica, although it may not dissolve all the carbonates. An example of this is given by Bodman. When a sample of Montezuma clay adobe subsoil from California was boiled with 0.1 *N* HCl, the amount of acid consumed was equivalent to 9.08 per cent. calcium carbonate; but if treated with 0.2 *N* HCl at room temperature in accordance with the international method, acid equivalent to only 1.27 per cent. of calcium carbonate was consumed, and part of this consumption must be ascribed to the solution of 0.81 per cent. of sesquioxides and silica. The amount of carbonates in this soil, determined by the official method was 8.28 per cent.

Even though carbonates might be removed completely and easily, such removal is undesirable in some soils, such as glacial soils containing large amounts of limestone or dolomite, because it would be likely to change soil textural classifications. Other soils may have relatively permanent grains or crystals of precipitated carbonate whose presence should be expressed in the results of mechanical analysis. An example of this is the Goliad fine sandy loam subsoil from Texas. Ten-gram samples of this material were treated with verying amounts of acid, following the regular peroxide treatment. The washed residues were shaken with 5 c.c. of normal sodium carbonate and analysed by the pipette method described later.

For some special purposes, such as dam construction or other engineering uses, an analysis based on vigorous acid treatment might be preferred for a soil such as the Goliad, although an analysis without acid treatment together with a determination of total carbonates would be preferable. Analyses by both methods are required to furnish a complete description of the soil.

Acid treatment may alter the amount of material in the different size classes enough to change markedly the textural classification. Incidentally it is not essential to good dispersion, a matter which will now be examined more fully.

Since it appears that treatment with 0.2 *N* HCl is not always effective in removing the carbonates from soil and in some cases presents a distorted picture of the soil, it seemed desirable to ascertain whether complete dispersion can be obtained without its use.

Washing.

After the soil sample has been pre-treated it is washed to remove soluble organic matter, dissolved lime, replaced ions (especially bivalent and trivalent cations), hydrogen peroxide, and excess acid if hydrochloric or acetic acid is used. Experiments by Wiegner indicate that the removal of electrolytes by thorough washing is necessary in order to obtain a high degree of dispersion by any subsequent treatment. Soils from humid regions are low in soluble salts and usually do not require much washing to prevent flocculation in the dispersion cylinder. For soils subject to low rainfall, however, thorough washing is essential to good dispersion.

As washing proceeds the soil, flocculated by acid treatment, gradually deflocculates again, slowing the filtering rate. Occasionally, however, a soil such as the Cecil of Georgia does not deflocculate on washing, for this reason it was chosen for the following test. Eight duplicate 10-gm. samples were given hydrogen peroxide and hydrochloric-acid treatment. The samples were then washed 1, 2, 4, 5, 6, 7, 9, and 15 times, respectively, by the method described later, and the amount of clay was determined by the pipette method. There was no correlation between the number of washings and the percentage of clay, the results agreeing within the limits of experimental error. The Cecil, a soil developed in a humid climate, is low in soluble salts and does not require much washing. The routine treatment is 6 washings of about 125 c.c. each, removing the solution completely each time. The entire operation requires about one day. When acid treatment is omitted only a fraction of 1 per cent. of soluble matter is removed by washing, and no chemical analysis of it is made.

Dispersing Agents.

The dispersing agents most used in mechanical analysis are ammonia, sodium hydroxide, and sodium carbonate. In the centrifuge method, in which the soil after dispersion is repeatedly washed and the percentage of clay determined by difference any of the dispersing agents may be used. When ammonia is used in the pipette method, the amount of ammonia held by

the dried colloid is somewhat uncertain. The pipetted solutions are alkaline and consequently absorb carbon dioxide from the air, giving an uncertain increase of weight of the aliquot. If sodium oxalate is used as a dispersing agent this difficulty disappears.

Ammonium and sodium hydroxide give good dispersion when calcium and magnesium carbonates have been removed from the soil. This removal requires a thorough acid pre-treatment and washing of the sample. If calcium carbonate remains in the soil after pre-treatment, sodium carbonate is a better dispersing agent than either sodium or ammonium hydroxide because the carbonate decreases the solubility of the calcium carbonate while the hydroxides may produce large amounts of the flocculating calcium ions. Sodium oxalate is even better as a dispersing agent than sodium carbonate. Unlike the hydroxides, sodium oxalate frees no alkaline earth hydroxides as a result of chemical equilibriums established. Also, the solubility of the oxalates of calcium and magnesium is much lower than that of the corresponding carbonates. The oxalate does not react with carbon dioxide from the air.

Surface layers of three soil types were treated with hydrogen peroxide but no acid, and shaken with the four dispersing agents, equimolecular concentrations being used. This is a smaller amount of ammonia than is generally used but is an adequate quantity of the other deflocculents. The total lime computed as $CaCO_3$ was less than 2 per cent. for the Carrington and Wabash soils and 18.9 per cent. for the Houston. The results indicate that ammonium and sodium hydroxides are not suitable deflocculents for soils which have not had acid pretreatment, and that, of the other two, sodium oxalate gives consistently higher results. The activity of the oxalate ion may cause this increased dispersion. Oxalic acid is often used to clean minerals for petrographic examination. Tests are soon to be made upon the efficiency of lithium oxalate as a deflocculent.

Occasionally a sample flocculates in the sedimentation chambers. This may occur with any of the dispersing agents and with or without a mild acid treatment. The difficulty may be due to the presence of some soluble soil material or of an excess or deficiency of dispersing agent. It is impossible to determine accurately from inspection which is the cause. No investigation of the electrokinetic potentials of these suspensions has been made, but a simple remedy has been found which usually restores dispersion. A Pasteur-Chamberland suction filter is placed in the suspension, and the liquid volume is reduced from 1,000 c.c. to some smaller definite volume, say, 200 or 250 c.c. Distilled water is then added to make up the original volume. The suspension is thoroughly stirred and allowed to stand. If flocculation again takes place measured amounts of deflocculent are added until the suspension is stable. This procedure leaves some uncertainty as to the weight of dispersing agent to be deducted from the pipetted aliquots. It is assumed that the filtrate removed has the same concentration as the material left in the cylinder.

Electrodialysis.

Another means of effecting dispersion is electrodialysis. For samples dispersed in this way the Mattson cell was used. By this method carbonates and "exchange bases" as well as the chlorides, sulphates, and phosphates can be removed; so that, in addition to giving an excellent pre-treatment for dispersion, electrodialysis enables one to determine the amount of "exchanbes bases" in the soil. The advantage of electrodialysis over hydrochloric acid treatment is that it does not introduce into the soil a foreign ion which must be washed out later. No washing is required after electrodialysis. The method requires considerable extra equipment, extra time, additional transfers of the sample with attendant possibilities of loss, and, where determination of exchangeable bases is not desired, yields no results that can not more easily be obtained by acid treatment.

Shaking.

After the hydrogen peroxide treatment, the sample is washed, dried at 105° C., and weighed. It is this weight which is later made the basis for the determination of the percentage of material in each size class when the results are used for textural classification. The dried sample is transferred to a 250 c.c. nursing bottle, the dispersing agent is added, and the material is shaken overnight. The shaker has a horizontal movement of 10 cm. and a rate of 120 complete oscillations per minute. Joseph and Snow find 2 hours' shaking to be sufficient. In the experiments of Davis and Middleton the material was shaen 7 hours. Since the samples used in the laboratory were first dried at 105° C. it is possible that longer shaking is required. Although 16 hours is longer shaking than necessary, it is convenient to let the shaker run overnight. The amount of grinding of soil grains is negligible.

(To be continued.)

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In the separation of Monazite Sand, two other important minerals are obtained as by-products, Ilmenite and Zircon.

Ilmenite is a Titanate of Iron, from which a pure white Oxide of Titanium can be obtained, although the mineral is black. Titanium Oxide is finding an increasing use in place of white lead in paint. In view of the legislation in recent years with regard to the obnoxious nature of Lead paints it *is of the greatest importance that a satis*factory substitute should be available, and a substitute which, in addition to being non-poisonous, has the advantage of having a greater covering power than either White Lead or Zinc Oxide.

In the manufacture of Titanium Oxide a very pure form of metallic iron is obtained, free from Silicon and Titanium. This iron will doubtless find a very special use in the future.

The mineral Zircon Sand is a Zircon Silicate from which is prepared a white Zirconium Oxide, employed for the manufacture of bricks for lining high-temperature furnaces. It has also found a use in replacing white Tin Oxide as an "Opacifier" in the manufacture of white resistant enamels.

MESSRS. HOWARDS AND SONS LTD.
Stand No. B. 106.

This firm will be exhibiting their usual range of solvents and plasticisers, well known in the cellulose and lacquer inlustry, together with their Sextol and Cyclo-Hexanol products for use in soap, textile, dry cleaning, *laundry and other industries.* The paint, lacquer and varnish trades will be interested in Sextone, Sextone B, Ethyl to-tate and Diacetone alcohol, the two tion. being particularly valuable for the dispersion *of flow and* brushing properties amined m brushing lacquers, whilst they ame time powerful solvents for te.

Messrs. Howards and Sons' fine chemicals *are particularly well known.* Amongst them will be found Thymol and Synthetic Menthol, Aspirin, Ethers, Iodides, Mercurials, Quinines, Bismuth Compounds, Bromides, Camphor, Salicylates, in fact all the pharmaceutical fine chemicals for which this firm is so justly famous.

MESSRS. JOHNSON & SONS (MANUFACTURING CHEMISTS) LTD.,
Stand No. B. 79.

Johnson & Sons Manufacturing Chemists Ltd., Works and Offices, Hendon, London. Branch Office, Queen Street, Deansgate, Manchester, are exhibiting on their Stand in the Chemical Section a full display of the Photographic Developing Agents such as Amidol-Johnsons, Metol-Johnsons, Pyro-Johnsons, Glycin-Johnsons, Azol, and all forms of the readymade Developers in Solution and Powder for use by all branches of the Profession, including Professionals, Trade Workers, Radiographers, Cinematographers, Process Engravers and Amateur Photographers.

There is also a display of Fine Chemicals including the Salts of precious metals, such as Gold Chloride, Silver Nitrate, Silver Vitellin, etc. A whole series of Test Books and Caustics, Pharmaceutical Preparations. Tinctures, Liquid Extracts, Infusions; also Counter Specialities suitable for the Retail Chemists trade including Lysol-Johnsons.

There is also a collection of Chemicals and Collodions as required by the Process Engraver.

MESSRS. MAY AND BAKER, LTD.
Stand No. A. 185.

Established in 1834, Messrs. May & Baker have consistently developed and extended their manufacthres and are now recognised as one of the leading firms of the Chemical Industry not only in the British Empire but throughout the world. Their manufactures cover a wide range of pharmaceutical and industrial chemicals and indeed all the more important salts and preparations officially recognised in the various pharmacoepias besides preparations, the product of their Research Department, which establish them in the front rank of firms necessary to the medical profession in their treatment of disease. In this connection organic arsenic compounds are probably of outstanding interest owing to the fact that recent progress in medical science has shewn their many-sided applications in the treatment of tropical and other diseases throughout the world; for example.—

Neovarsenobilon. (*N.A.B.*) now universally recognised as the standard preparation for the treatment of syphilis. It has been manufactured by May & Baker since the earliest days of the war when supplies, previously produced only in Germany, were unobtainable. This preparation is also an efficient remedy in the treatment of a number of diseases peculiar to the tropics, such as Yaws, Recurrent Fever, Anthrax, etc. (This and several other products of the same type are manufactured under special licence of the Ministry of Health and are tested in the Biological Standards Department of the Medical Research Council.

Stovarsol, widely used in the treatment of Amoebic Dysentry, Yaws, Tick Fever, etc., has the advantage shared by few arsenical compounds of being capable of oral administration.

Quinine-Troposan, used in the treatment of Disseminated Sclerosis and Neurosyphilis, are products of low toxicity and may be administered by the mouth in large doses.

Tryparsamide, as sole licencees in Great Britain of the Rockfeller Institute of New York, May & Baker manufacture this product, an organic arsenic derivative which was the outcome of systematic research at the Rockefeller Institute and has proved to be the only organic compound of real value in the treatment of sleeping sickness.

The series of hypnotics include Cardenal, Soneryl and Rutonal, the first of which is now widely used in the treatment of Epilepsy.

The firm's manufactures of salts and preparations officially recognised in the various pharmacoepias include the Salts of Bismuth, Mercurial Salts, Iodides, Bromides, etc., etc., and Ether and Chloroform for anaesthetic purposes, the use of which in many of the largest hospitals throughout the country testifies to their excellence and reliability.

On the industrial side the firm are the largest manufacturers of Mercurial preparations in the Empire and of these may be mentioned Mercuric Oxide, extensively used in the preparation of anti-fouling paints, Vermilion, used in the paint industry generally, and Corrosive Sublimate, employed in the preservation of timber for disinfecting purposes, etc.

The export trade of the firm is handled by employees specialised in the particular markets and the development of this branch of the business has led to the establishment of separate organisations both in India and Canada, the firms of May & Baker (India) Ltd., and May & Baker (Canada) Ltd. having been incorporated during the past twelve months with head offices in Calcutta and Montreal respectively. Customers in these territories can now place their orders for May & Baker products with these houses for immediate delivery from stock.

May & Baker are at all times ready to consider the manufacture of new products and to investigate and advise on technical problems submitted to them.

BRITISH INDUSTRIES FAIR, BIRMINGHAM.

At the British Industries Fair at Birmingham, Messrs. Allen-Liversidge, Ltd., the Welding and Acetylene Engineers, are showing a full range of welding equipment—Oxy-Acetylene, Electric Arc, and Electric Resistance. These three processes between them cover almost the entire welding field, from individual repair jobs to mass production of thousands of welds per hour with a resistance welder. The oxy-acetylene equipment shown includes high pressure welding outfits which employ dissolved acetylene in cylinders as well as the compressed oxygen. and low pressure plant for which the acetylene supply is drawn from a generator.

In recent years, welding has more and more come to be considered not merely as mainly a useful repairing process, but as a valuable production process also, and many of these outfits have been bought for regular production work. This increased use of welding has in many cases resulted in changes in design since it is upon this factor of design that the efficient use of welding largely depends. An interesting aspect of welding progress is the frequent substitution of arc welded steel structures for iron castings. Considerable savings have been effected in this way particularly where relatively few castings are to be taken from the same pattern and where consequently the cost per casting is considerable.

Oxy-acetylene outfits similar to the welding outfits but with a different blowpipe and regulator are used also, of course, for metal-cutting. Remarkable results can be obtained; for instance 1in. mild steel plate can be cut at a speed of about 40ft. per hour with an oxygen consumption of about 88 cu. ft. per hour, the acetylene consumption being considerably less. Dissolved acetylene is used also in combination with atmospheric air for work such as brazing, soldering, and paintburning, light portable outfits being supplied for these purposes.

By the use of a specially constructed blowpipe and pressure reducing regulator an oxy-acetylene flame suitable for leadburning can be obtained. This system is now being widely employed.

By attaching a suitable fitment carrying a burner and reflector to a cylinder of dissolved acetylene, a powerful storm-proof flare-light is formed. These flare-lights, which provide a candle power of from 1,000 to 15,000 according to size, and have burning periods from one cylinder of from 8 to 66 hours, are of considerable value to builders, contractors, and others who are engaged in night work out-of-doors.

Electric welding can be divided into two types—electric arc and electric recictance, and electric resistance welding into three further types—spot, seam, and butt. Examples of each of these types will be shown.

Arc welding is employed mainly on heavy sections of metal, and in this field is an extremely economical jointing process. Motor generator sets can be driven either by A.C. or D.C. motors or by a belt-drive from an oil or petrol engine. A.C. transformers may also be employed for arc welding.

"Pontelec" resistance welding machines, (which are manufactured by Buckley, Saunders & Co., Ltd., in Birmingham), for which Allen-Liversidge, Ltd., are sole selling agents, are employed mainly for repetition work; usually, but not necessarily, on light sections of metal. Remarkable results can be obtained as the following representative figures indicate :—

PARTICULARS AND COST OF SPOT WELDING WITH A-L "PONTELEC" MACHINES ON CLEAN MILD STEEL PLATE.

Single metal thickness	Total aggregate thickness *inches*	Welds per unit *approx.*	Time of each weld weld in *seconds*	Diameter of spot. *inches*	Approx. cost of 100 welds at 1d. per unit.
34 S.W.G.	.0184	4800	.25	1 16	1/48 of 1d.
28 ,,	.0296	3400	.3	1/16	1/34 ,, ,,
26 ,,	.036	1800	.5	1/8	1/8 ,, ,,
24 ,,	.044	1450	.5	1/8	2/29 ,, ,,
22 ,,	.056	1200	.6	1/8	1/12 ,, ,,
20 ,,	.072	1000	.6	1/8	1/10 ,, ,,
18 ,,	.096	850	.7	1/8	2/17 ,, ,,
16 ,,	.128	750	.8	3/16	2/15 ,, ,,
14 ,,	.160	515	1.0	3/16	20/103 ,, ,,
12 ,,	.208	360	1.25	3/16	5/18 ,, ,,
10 ,,	.256	240	1.5	3/16	5/12 ,, ,,

PARTICULARS AND COST OF SEAM WELDING WITH A-L "PONTELEC" MACHINES ON GOOD QUALITY MILD STEEL PICKLED SHEETS.

Gauge No.	Thickness in inches	Max. K.W.	Welding speed in feet per minute	Units consumed per 100 ft.
34	.0092	4	10	.66
28	.0148	6	10	1.25
24	.022	8	6	2.2
22	.028	9½	6	2.6
20	.036	12	4	5
18	.048	15	8	8.25
16	.064	18	8	9.9
14	.08	20	8	11
12	.104	25	8	14
10	.128	30	8	16.5

An interesting subsidiary use of dissolved acetylene is for lighting and cooking on motor boats and yachts, and in small huts and camps. The gas is led from the cylinder through rubber (or in the case of a more permanent installation, brass) tubing to the lights or stoves required, and the apparatus is then used just like a gas stove in a town house. No mantles are used for the lights, and the cooking is done somewhat more quickly than on a coal-gas stove. The exchange of empty cylinders for full ones is, of course, a simple matter and takes only a few minutes.

The whole of these products will be in working order, and demonstrations of any machine or equipment will be given.

GENERAL NOTES.

CHEMICALS FOR INDIA.

His Majesty's Trade Commissioner in Calcutta reports that the Indian Stores Department is calling for tenders, to be presented in New Delhi by the 18th February, 1930, for the supply of liquid chlorine, alumina-ferric and sulphate of alumina (Order No. H-6860).

Firms desirous of offering chemicals of British manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X. 6143 should be quoted.

DISINFECTING FLUID FOR INDIA.

His Majesty's Trade Commissioner at Calcutta reports that the Indian Stores Department is calling for teuders, to be presented in New Delhi by the 24th February, 1930, for the supply of disinfecting fluid (Order No. H-6927).

Firms desirous of offering disinfecting fluid of British manufacture can obtain further particulars of this call for teuders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number BX. 6144 should be quoted.

MINES BILL AND GAS INDUSTRY.

The serious effect which the passing of the Coal Mines Bill will have on the Gas Industry and the price of gas to the consumer, is one of the features of the Annual Report of the directors of the South Metropolitan Gas Company now being issued to shareholders.

Dr. Charles Carpenter, the President, says the bill has thrown a cloud over the undertaking, indeed over the entire gas industry. "It is untrue to suggest," he adds, "that the Company has paid less than a commercial or market price for its coal; upon occasions the cost has been unduly high. The prospects of having to purchase coal in a restricted instead of an open market, and of the compulsory amalgamation of collieries, whether well-managed or ill-managed, profitable or unprofitable, are viewed with apprehension by your directors."

The comprehensive Co-partnership scheme, for which nearly £84,000 is this year allocated, is also referred to, and special mention is made of its usefulness in maintaining a cordial understanding between employer and employed.

SIR ERNEST RUTHERFORD RECEIVES THE FARADAY MEDAL.

The Council of the Institution of Electrical Engineers have made the ninth award of the Faraday Medal to Sir Ernest Rutherford, O.M., F.R.S.

The Faraday Medal is awarded by the Council of the Institution not more frequently than once a year either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science without restriction as regards nationality, country of residence, or membership of the Institution.

PHOTOCHEMISTRY.

The First Report of the Committee on Photochemistry, which was originally published in the *Journal of Physical Chemistry* in 1928, has been reprinted by the U.S. National Research Council as *Bulletin* No. 81 (Pp. 86. Price one dollar).

It contains the following six papers by members of the Committee (which was under the chairmanship of Prof. H. S. Taylor):—

Experimental Technique for Quantitative Study of Photochemical Reactions. By G. S. FORBES.

Absorption Coefficients. By H. G. DE LASZLO.

The Excited Systems formed by the Absorption of Light. By L. A. TURNER.

Quantum Processes in Photochemistry. By H. S. TAYLOR.

The Displacement of Equilibria by Light. By WILDER D. BANCROFT.

Relation Between Photochemical and Ionisation Reactions. By C. S. LIND.

These contributions represent the initial effort of the Committee on Photochemistry to promote a further interest in the problems of the subject which has undergone considerable expansion during the last decade consequent upon the adoption of new ideas in respect to the nature of light and the processes of its absorption by atoms and molecules. The concept of light quanta is mainly responsible for this and the report includes a survey from both the classical angle (by Prof. Bancroft) and from the quantised adsorption standpoint (by Prof. Turner).

MINERAL PRODUCTION IN BRITISH COLUMBIA, 1929.

NEW RECORD VALUE.

The British Columbia Department of Mines has forwarded to the High Commissioner of Canada and the Agent-General for British Columbia in London a preliminary review and summary of mining operations, indicating that the gross value of the mineral production in that Province last year is estimated at $70,030,976, a new high record in the history of British Columbia mining. This figure is $4,658,393, or 7.13 per cent. greater than the value of the output in 1928.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, February 13.

The following papers were read :—

Studies on the Rhone Glacier, 1927. The Structure of the Ice in a Compressed Zone on the South Eastern part of the Glacier. By G. SLATER. Communicated by Prof. W. W. Watts, F.R.S.

In the south easterly embayment of the Rhone Glacier a compressed zone of ice is marked by a series of ridges dissected by three crevassed longitudinal basins. The structure of the easterly ridge, which was plotted to scale, showed a complete disarrangement of the normal ribbon structure, the ice being dissected into blocks by thrust-planes. The general strike of the thrust-planes suggests a pivotal movement southwards of the ice, the basins representing tensional areas due to this deviation from the normal south-westerly movement of the glacier. Hence relief from pressure was obtained by upward movement along the thrust-planes, and by lateral squeezing towards the tensional areas.

The structure developed in the glacier is the same in principle as that of the disturbed Pleistocene drift deposits of Europe and America. These deposits represent englacial material which has been moulded into the structures developed in the ice, and finally preserved as pseudomorphs.

*On a Remarkable New Newmatode, Tylenchinema oscinellae gen. et sp. n., Parasitic in the Frit-fly, Oscinella frit L, attacking Oats....*T. GOODEY. Communicated by Prof. R. T. Leiper, F.R.S.

Ensheathed larvæ and young adults of a Tylenchoid nematode were found in oat stems attacked by Frit-fly, in débris surrounding larvae of the fly. The parasite is widely distributed in England and Wales.

The nematode and its life-history are described. The development of the gonad is given in detail for both sexes, as well as the subsequent growth of the female's reproductive organs.

The relations of host and parasite are described, the general result for the host being sterilisation.

The systematic position of the nematode is discussed and the new genus Tylenchinema erected for its reception.

Distortion of Development in Amphibia caused by lack of Oxygen in very early Stages in Development. D. E. SLADDEN. Communicated by Prof. G. W. MacBride. F.R.S.

Eggs of the common frog (*Rana temporaria*), when deprived of oxygen at an early stage in development, either by means of sugar-solution or subjecting them to reduced air pressure, gave rise to tadpoles showing various types of abnormalities.

The principal types were as follows :—

Distension of body cavity; Rupture of gut-wall caused possibly by the absorption of water and consequent swelling of the yolk, which was extruded into the body-cavity; Flexure of tail due to a defect in the myotomic-formation. Distortion of sacral region in a metamorphosed frog resulting from the flexure of the tail. Suppression of the hind limb due to compression at an early period of development.

The abnormalities present at the time of hatching died shortly after, leaving only apparently normal larvae. From among these, however, after a period of eight weeks, abnormalities showing flexure in tail, distortion of sacral region, and in one

case suppression of hind limb, made their appearance. These latter were successfully reared through metamorphoses.

The Integration of Plant Behaviour. Part II. The Influence of the Shoot on the Growth of Roots in Seedlings. By SIR FREDERICK KEEBLE, F.R.S., M. G. NELSON, AND R. SNOW.

By the removal of the shoot in young pea seedlings or af the shoot and coleoptile in young maize seedlings, two opposite effects are produced upon the growth of roots. The growth of tne main root is slightly increased for a few days, but the growth of secondary or adventitious roots is decreased, but to a much less extent.

Reasons are given for cousidering that the decrease in the growth of lateral roots is similar to the decrease in the formation of roots in woody cuttings which is caused by removal of their buds, and that it is due to the lack of some favourable influence that normally comes from the young shoot.

The Results of Testicular Transplantation in Brown Leghorn Hens. A . W. GREENWOOD and J. S. S. BLYTH. Communicated by F. H. A. Marshall, F.R.S.

In a series of normal hens it has been found possible to obtain persistent grafts of testicular substance.

Modification in the function of the ovary have been produced, both in regard to the production of eggs and to the development of the secondary sex characters.

The bearing of these results on the divergent theories of Steinach, Sand and Moore with regard to gonad interaction and function is discussed.

The Hypothalamus and the Sympathetic Nervous System. J. BEATTIE, G. R. BROW and C. N. H. LONG. Communicated by J. P. Hill, F.R.S.

THE PHYSICAL SOCIETY.

Friday, February 14.

The Diffusion Constant of Water Vapour. By W. E. SUMMERHAYS, B.Sc., The University of Birmingham.

Water vapour was allowed to diffuse down a vertical tube about 2 in. in diameter, a steady concentration-gradient being maintained from approximate saturation at the top to approximate dryness at the bottom. The gradient was measured with two katharometers at a definite distance apart and the mass of vapour passing in an observed time was weighed. The result given is 0.281 cm.^{2}/sec. at mean temperature 16.1° C.

A Method of Calculating the Numerical Equation of State for Helium below 6° Abs., and of Estimating the Relative Importance of Gas Degeneracy and Interatomic Forces. By M. C. JOHNSON, M.A., M.Sc., Physics Department, University of Birmingham.

Gas " degeneracy " (the effect of non-Maxwellian distributiou of molecular velocities) is distinguished from gas " imperfection " (the effect of intermolecular forces), and it is shown that specific heat measurements cannot be used to verify theories of the former unless account is taken of the very rapid increase of the latter at the lowest temperatures and highest pressures. Accordingly a thermodynamic method is used to calculate the sum of degeneracy and imperfection at 4° and 5° Absolute for helium. Theories of degeneracy can then be roughly tested by the extent to which they allow a residual value of the imperfection to be calculated, and to determine a consistent extension of the course taken by isothermals down to 15°. The method is applied to Fermi's expressions for degeneracy, and also to Berthelot's equation of state. One of the equations alone satisfies the required condition, and it is shown that on this basis degeneracy would comprise 15 per cent. of the total departure of helium from ideal gas laws at 4° and 5°, the remainder being due to true imperfection or intermolecular forces.

The Magnetostriction Constant for Alternating Magnetic Field. By F. D. SMITH, M.Sc., A.M.I.E.E.

A magnetostriction constant K for the Joule effect is defined by the equation $p=KH$ where p is the alternating mechanical stress produced by a small alternating magnetic field H superposed on a steady magnetic field H_0. It is shown that the alternating intensity of magnetisation I produced by an alternating strain $\delta l/l$ is given by the equation $I=K\delta l/l$, K being the same constant in both equations. These equations are used to calculate the motional impedance of a laminated ring toroidally wound and vibrating in its fundamental radial mode. K has been measured for various values of H_0 with a ring of the alloy Fe 60 per cent., Ni 40 per cent. It is shown that the magnetostriction effect for steady magnetising fields can be inferred from the measurements with alternating magnetic fields, if the reversible permeability and the differential permeability of the alloy are known.

SOCIETY OF PUBLIC ANALYSTS.

An ordinary meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, February 5, the President, Mr. Edward Hinks, being in the chair.

The President announced the names of those who had been nominated as Officers and Members of Council for the coming year.

Certificates were read for the first time in favour of Leslie Mansfield Adams, James Charles Harral, Donald Frank Harrington Button, A.R.C.S., A.I.C., Hugh Childs, B.Sc., F.I.C., John William Corran, B.Sc., Ph.D., F.I.C., Archibald Orton Jones, M.A., F.I.C., James Bruce Eric Patterson, M.Sc., A.I.C., Frank James Smith, B.Sc., A.I.C., Alfred Tingle, B.Sc., Ph.D.

Certificates were read for the second time in favour of Ronald Gilbert Baskett, B.Sc., Hugh Charles Loudon Bloxam, F.I.C., Claud McClellan Bottomley, B.Sc., John Butler, F.I.C., Robert Ellison, A.M.C.T., George Noel Grinling, F.I.C., Albert Houlbrooke, M.Sc., A.I.C.; Philip Henry Jones, F.I.C., Raymond Mallinder ,Sydney Norman Herbert Stothart, B.Sc., Ph.D., A.I.C., Hubert Threadgold, B.Sc., A.I.C.

The following were elected Members of the Society :— Noel Lionel Allport, A.I.C., James Gilbert Lunt, B.Sc., A.I.C., Fred Morris, F.I.C., Albert William Peters, Juda Hirsch Quastel, D.Sc., Ph.D., A.R.C.S., A.I.C., and Joseph Harold Totton, B.A., B.Sc., F.I.C.

The following papers were read and discussed :—

The Determination of Minute Amounts of Iodine in Soils and Waters. By R. L. Andrew.

A modification of Fellenberg's method has been devised, in which special means are taken to free the reagents (alcohol, chloroform and potassium carbonate) from all traces of iodine. The losses occurring at the different stages of the process, which are probably not entirely attributable to overheating, cannot be altogether eliminated. From 60 to 70 per cent. of iodine added to a soil can be recovered. The results obtained by colorimetric methods are shown [illegible]e more trustworthy than those obtained thr[illegible]tration. Soils from the North Island thr[illegible]w Zealand contained from 10 to 2,100 south of iodine in 10 millions, and the ing te[illegible] waters from 0.004 to 0.120 part from th[illegible]illions.

Preliminary Studies in the Bacteriology of Wheat and Flour. By D. W. Kent-Jones, Ph.D., B.Sc., F.I.C., and A. J. Amos, B.Sc., A.I.C.

A definite and satisfactory procedure for enumerating bacteria in wheat and flour has been devised. From the data so far collected it appears that freshly and normally milled patent flour contains less than 20,000 blood-heat bacteria, straight run flour less than 50,000, and lower grade flour up to 300,000 per grm. The cool organism content of any grade is nearly always greater than the figure for the blood-heat organisms. Storage of a flour results in a considerable decrease in the number of both forms. Many of the more common flour bacteria have been identified or their cultural and physiological characteristics established. Organisms of the *B. mesentericus* group are almost universally present in flour and bread.

The Separation of Metals by "Internal Electrolysis." By H. J. S. Sand, D.Sc., Ph.D., F.I.C.

The metal to be determined is deposited on a platinum cathode, the essential feature of the method being that no electric current is introduced from outside, but, instead, an anode of the baser metal is employed, which is placed in contact with a solution of one of its salts in a compartment separated by a parchment membrane from the solution to be examined.

The Rapid Determination of Bismuth and Copper in Lead Bullion by Internal Electrolysis. By Ella M. Collin, B.Sc., A.I.C.

The method of "internal electrolysis" has been used to separate small quantities of bismuth and copper from large amounts of lead, the less basic metals being displaced from solution by means of lead, without any external E.M.F. In applying the method to the analysis of lead bullion, impurities other than bismuth or copper are either precipitated or are prevented from being deposited.

Notes on the Thiocyanate Method of Determining Iron. Influence of Different Classes of Phosphates. By G. Winthrop Leeper, M.Sc.

Orthophosphates do not interfere with the thiocyanate reaction provided that the ratio of phosphoric anhydride to iron does not exceed 100 mgrms. to 0.02 mgrm. It is essential, however, that when extracting the ashed material with acid sufficient time is allowed for any pyrophosphate formed to be reconverted into orthophosphate. Both pyrophosphates and metaphosphates rapidly destroy the colour of ferric thiocyanate.

NOTICES OF BOOKS.

(1) *Elementary Inorganic Chemistry*. By J. W. MELLOR, D.Sc., F.R.S. Pp. x + 229. London : Longmans, Green & Co. 1930. Price 3s. 6d.

(2) *Intermediate Inorganic Chemistry*. By J. W. MELLOR, D.Sc., F.R.S. Pp. xx + 690. London : Longmans, Green & Co.. 1930. Price 7s. 6d.

Both these volumes can be strongly recommended to science masters and the teaching profession generally. Dr. Mellor is perhaps the most prolific writer in chemistry at the present time and science owes him a deep debt of gratitude for his complete and comprehensive Treatises on Inorganic Chemistry. His earlier " Modern Inorganic Chemistry " has now been subjected to " reproduction by growth and fission," and in the first of the two text-books before us he presents beginners with the subject in an easy and simple style dealing with the physical properties of air, its chemical nature, the three gases hydrogen, oxygen and nitrogen, mixtures and compounds, the atomic hypothesis, ice, water and steam, composition of water, a study of salt, acids bases and salts, a study of chalk, a study of carbon, the oxides of carbon, combustion and flame, sulphur, nitre, ammonia and finally bone-ash.

The second volume carries the student much farther and deals with the whole domain of inorganic chemistry, its theories and the outlines of physical chemistry. For the student also there are a number of examination questions appended to each chapter.

In the Preface Dr. Mellor asks : " What may a student ask from a general course of chemistry ? " and he proceeds to suggest the results should include (1) Skill in observation and experiment; (2) memory and knowledge of relevant facts; (3) ability to reason and think in a logical systematic way; (4) cultivation of the imagination; and (5) development of a critical and impartial judgment.

In most instances the experiments and illustrations are well chosen and the facts well presented and theories well expressed. At times the author has found it hard to keep up with the rapid progress going on in every section of the subject and without attempting to detract from the great merits of these two valuable volumes we might ask why Dr. Mellor speaks of " The Bunsen's Burner " (p. 458, of *Intermediate Inorganic Chemistry*.) Again, in dealing with the discovery of the congeners of manganese, he terms element of atomic number 43 masrium (p. 628), a name assigned by H. Droop Richmond and Hussein Off in 1892 to a supposed element in Egyptian masrite.

The Tables of Atomic Weights are also not up to date, although the differences are negligible, but it is no longer possible to say, as Mellor does in both the above books, that 90 per cent. of the world's sulphur comes from Sicily. Also geographical changes have occurred since 1914 and it behoves all writers to ascertain the whereabouts of all places that they have occasion to mention. The Adelsberg stalactite caverns are no longer in Austria but Italy (p. 147 of *Elementary Inorganic Chemistry*).

German for Chemists. By PROF. LOUIS DE VRIES. Pp. vi + 180. Chemical Publishing Co., Easton, P a., U.S.A. 1930. Price 3 dollars.

English-speaking peoples are at an advantage in the world as regards language for there are more journals published in our language than in any other. Nevertheless, science is international, and anyone who desires to keep abreast of modern discoveries and developments must either acquire a good working knowledge of, say, two other languages or depend upon the abstracting journals for his latest information. These are by no means infallible (they sometimes omit reference to important work, they may not abstract a foreign article for some time, and they may give a poor summary of something really important) so that it is almost essential for students to-day to be able to read, if not to write, German.

Prof. de Vries' *German for Chemists* meets, therefore, a real need. It inclndes graduated texts from distinguished German scientists such as Emil Fischer, Wilh. Ostwald, Kekule, Arrhenius, Niels Bohr, etc. The author has selected self-contained essays and articles, interesting in themselves as well as in making the student familiar with German scientific writing. An extensive German-English vocabulary is appended, and the book should be of service to teachers of science and to students anxious to acquire a knowledge of scientific German.

L'Atomistica Moderna e La Chimica. By DR. M. HAISSINSKY. Pp. xvi + 316. Milan; Ulrico Hoepli. 1930. Price 35 lire.

Dr. Haissinsky has compiled an Italian work upon the recent development in the chemistry and physics of the atom. He has briefly sketched the development of the Atomic Theory from antiquity, through

Dalton, to the present views on the electronic structure of matter, and after an account of the significance of the constant, e/m, he goes on to rescribe the phenomena of radioactivity and X-rays. This leads up to an account of Mendeléef's classification of the elements and its applications, mention being made of the isolation of Florentium (of Illinium, of atomic number 61), Hafnium (or Celtium) and other recent discoveries in this field.

Thermodynamics and the Quantum Theory are briefly considered before a lengthy chapter on the electronic conception of valency. Photochemistry, Catalysis and Wave Mechanics are also the subjects of subsequent chapters in which much modern work has been incorporated although, perhaps naturally, attention has been mostly focussed upon Italian contributions to this special branch of physical chemistry.

An appreciative preface to this work has been written by Prof. N. Parravano.

Sulphuric Acid and Its Manufacture. By Dr. H. A. Auden. Pp. viii + 231. London: Longmans Green & Co., 39, Paternoster Row, E.C. 1930. Price 16s.

Dr. Auden has written a most interesting volume which is designed to inform the ordinary student of applied chemistry and to enable him to grasp the fundamental problems connected with the manufacture of sulphuric acid by both the "lead chamber" and "contact" processes. The author begins with the history of sulphuric acid and its preparation. From this he goes on to give an account of its properties, and its handling and then its manufacture with special reference to the technicalities of the processes and plant. The book is not overburdened with details and is indeed not intended so much as a reference book but as a definite monograph which sets out to describe the subject in perspective.

Some of the older processes are mentioned on account of special interest attaching to them but obsolete procedure has, in general, been omitted.

The book should not only appeal to technologists and those concerned with the chemical industry, but it should also thr w chemists in general.
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INSTITUTE OF METALS.

PROGRAMME OF FORTHCOMING EVENTS.

This year's Annual May Lecture of the Institute of Metals will be delivered by Major F. A. Freeth, O.B.E., D.Sc., Ph.D., F.R.S., (Research Manager, Imperial Imperial Chemical Industries Limited) on "The Influence of Technique on Research."

The twenty-second Annual General Meeting of the Institute will be held on March 12-13, when fourteen papers will be presented.

The Annual Dinner and Dance will take place in the evening of March 12, at the Hotel Victoria. The price of tickets is 15s. up to February 15, after that date the price will be £1.

An official visit of Members of the Institute of Metals is being paid on February 21 to the British Industries Fair, Castle Bromwich. The Members will be entertained to luncheon by the Fair Committee.

In September the Institute will visit Southampton for the purpose of holding the Annual Autumn Meeting.

Full details regarding these gatherings, together with particulars of the next membership election, which covers not the usual twelve months but the extended period ending June 30, 1931, can be obtained on aplication to the Secretary, Mr. G. Shaw Scott, M.Sc., 36, Victoria Street, London, S.M.1.

COMPETITION OF INDUSTRIAL DESIGNS.

Particulars of the Seventh Annual Open Competition of Industrial Designs, to be held at the Imperial Institute, South Kensington, London, S.W.7., in June, have now been issued, and can be obtained from the Secretary of the Royal Society of Arts, John Street, Adelphi, W.C.2.

Intending competitors must apply to the Secretary of the Society between May 1 and 10 for the necessar yentry forms, the last day for receiving entries meing May 26. The resigns will be received at the Imperial College of Science and Technology, Imperial Institute Road, S.W.7., between June 11 and 13. In all, scholarships and prizes amounting to nearly £1,900 are offered in connection with the 1930 competition, which will be divided under the following heads:—(1) Architectural decoration; (2) textiles; (3) furniture; (4) book production; (5) pottery and glass; and (6) advertising.

Forthcoming Events.

PRAGUE HEALTH AND MUNICIPAL HYGIENE CONGRESS IN MARCH.

Among the papers to be read and discussed at the Health and Municipal Hygiene Congress to be held in Prague from 16 to 18 March, are the following :—

"The Health Services in Czechoslovakia." By Dr. L. P. Prochazka;

"Balneo-technique and Water Supplies." By Dr. J. V. Hrasky.

"The Equipment of Public Baths." By V. Benes.

"Water Supplies for Large Districts." By Dr. V. Cerny.

Excursions will be made to the new municipal gas works near Prague, the Masaryk Convalescent Home at Krc, the new library buildings, the Water Filtration plant at Podoli, the Pilsen breweries, and the Jachymov radium mines and curative baths.

SOCIETY OF PUBLIC ANALYSTS.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society will be held on Wednesday, March 5, at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1., at 8 p.m.

The Accounts for the year will be presented, the President will deliver his Annual Address, and the election of Officers and Council for the ensuing term will take place. The appointment of Auditors will be made.

The Ordinary Monthly Meeting of the Society will be held immediately following the Annual General Meeting, when the following papers will be read :—

(1) "The Spectroscopic Investigation of Jams and the like."

(2) "A Simple Polarimetric Test for Sugars in Jams."

(3) "A New Kjeldahl Distillation Apparatus." By S. Judd Lewis, D.Sc., F.I.C.

"The Detection and Identification of Alkaloids in the Saliva and Salivary Glands." By Professor M. S. Eldin Bey, B.Sc.

ROYAL INSTITUTION.

Tuesday, February 25, at 5.15 p.m.—"X-Ray Determination of the Structure of Cellulose." By Sir William Bragg, F.R.S.

Thursday, February 27, at 5.15 p.m.—"Some Problems of Genetics." By J. B. S. Haldane.

ROYAL SOCIETY OF ARTS.

Monday, February 24, at 8 p.m.—(Cantor Lecture.) Alfred B. Searle: "Recent Improvements in Methods of Bricklaying."

Tuesday, February 25, at 4.30 p.m.—Dominions and Colonies Meeting.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

2,013.—I. G. Farbenindustrie Akt.-Ges. Manufacture of azo dyestuffs. January 20.

2,264.—I. G. Farbenindustrie Akt.-Ges. —*Manufacture of chlorine compounds.* January 22.

2,266.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of amino-aryl-thiazole compounds. January 22.

1,976.—I. G. Farbenindustrie Akt.-Ges. —Treatment of gases containing hydrogen. January 20.

Specifications Published.

303,494.—Suida, Dr. H.—Production of concentrated acetic acid.

303,495.—Suida, Dr. H.—Production of acetic acid.

324,017.—I. G. Farbenindustrie Akt.Ges. —Manufacture of dyestuffs and dyestuff intermediates of the dinaphthylene dioxide series.

Abstract Published.

322,437.—Fatty acids.—I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Unsaturated long chain fatty acids are prepared by distilling the crude oxidation products, containing hydroxycarboxylic acids, of paraffin and the like waxes. The mixture of acids may be hydrogenated to saturated acids for the production of solid edible fats. The distillation is carried out at atmospheric or reduced pressure and at such a high temperature that the said unsaturated acids collect in the distillate and if desired in the presence of steam or inert gases. If desired a catalyst such as red phosphorus, sulphuric acid or metal oxides

may be employed in the distillation. Unoxidised products may be removed from the crude oxidation products by mechanical pressure or sweating. In examples, the oxidation products obtained from hard paraffin wax are distilled in a vacuum at 110 to 280° C., and the distillate is redistilled in an atmosphere of carbon dioxide. The oxidation products from montan wax, beeswax, ozokerite and the like may be similarly treated. An oxidation product of soft paraffin wax of brown coal tar is distilled while passing through a current of steam and raising the temperature to 260° C. The oxidation product of liquid paraffin wax or of montan wax may be similarly treated.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

PROLAPIN.

508,555.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research and anti-corrosives.—Chemical Building Products, Ltd., Kern House, 36 and 38, Kingsway, London, W.C.2. January 29. (To be associated with *No. 508,556 (2707) xvii.*

STELACTIV.

508,580.—A chemical substance for regenerating and refining iron and steel.—Alois Rob, Rheinstrasse 6, Weil-Friedlingen, Germany. January 29.

LITHURIN.

508,557.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research and anti-corrosives.—Chemical Building Products, Ltd., Kern House, 36 and 38, Kingsway, London, W.C.2. January 29. (To be associated with No. 508,558 (2705) xvii.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

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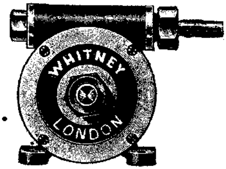

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THE ROYAL SOCIETY.

Government Grant for Scientific Investigations.

Applications for the year 1930 must be received at the Offices of the Royal Society not later than MARCH 31ST Next, and must be made on Printed Forms to be obtained from the Clerk to the Government Grant Committee, Royal Society, Burlington House, London, W.1.

NOTICE TO AUTHORS AND CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

A PIPETTE METHOD OF MECHANICAL ANALYSIS OF SOILS BASED ON IMPROVED DISPERSION PROCEDURE.

By L. B. Olmstead, Lyle T. Alexander, and H. E. Middleton, *Division of Soil Chemistry and Physics, Soil Investigations, Bureau of Chemistry and Soils, U.S. Department of Agriculture.*

(*Continued from page 117.*)

Separation Into Size Classes.

Size Classes Employed.

Early in the work of the former Bureau of Soils, the soil sample for mechanical analysis was separated into the following seven size classes :

Diameter, mm.	Conventional name.
2.0 to 1.0	Fine gravel.
1.0 to 0.5	Coarse sand.
0.5 to 0.25	Medium sand.
0.25 to 0.10... ...	Fine sand.
0.10 to 0.05... ...	Very fine sand.
0.05 to 0.005 ...	Silt.
>0.005	Clay.

Analyses based on the percentage by weight of these size classes are used by the bureau for the textural classification of soils. The bureau's records contain some 50,000 analyses based on these size classes, and for this reason no change has been made in these classes except to report also the amonnt of material below 2 μ effective diameter. This is called the " colloid " fraction. The 5 μ clay and the 2 μ " colloid " both contain particles below diameters of 5 μ and 2 μ respectively. Usually less than 10 percent of the clay is between 5 μ and 2 μ in effective diameter. Most of the material below 2 μ has a diameter of only a few tenths of a micron or less, so this fraction may be regarded as essentially colloidal in character. In addition to the eight size classes, this laboratory reports the loss by pretreatment of organic matter and soluble material. When acid treatment is omitted the solntion represents roughly the amount of organic matter. Neither the solution loss nor the amount of 2 μ colloid is used in textural classification. They are reported for information only.

The number of sand fractions may be greater than necessary, but these separations are quickly and easily made. The decimal system of grading, with separations made at 2.0, 0.2, 0.02, and 0.002 mm., would not furnish an adequate number of size classes for the extensive system of textural classifi- ...n of soils used in the United States. ...h the coarse clay is silty in charac- ... larger silt might be classed as 88, ... it now seems desirable to Janua. ...ent size classification. The with Nc ... would be to omit the 5 μ separation, place the material between 5 μ and 2 μ in the silt class, and also omit the 1 mm. sand separation, throwing the material between 2 mm. and 0.5 mm. into one class.

Method of Separation.

After the sample has been shaken with dispersing agent it is wet sieved through a Tyler 300-mesh phosphor bronze twilled wire cloth screen, which passes material finer than 5 μ equivalent diameter. All the clay aud the finer portion of the silt is washed through the sieve into a 1-liter sedimentation chamber. The silt remaining with the sands is dry sifted through another 300-mesh sieve added to the rest of sand sieves.

The sedimentation chamber contains only fine material with low settling velocities where the accuracy of pipette sampling is greatest. The suspension in the sedimentation chamber is stirred, and an aliquot is quickly taken with a 25 c.c. Lowy automatic pipette. After the suspension has stood 77 minutes (at 20° C.), and again after standing 8 hours, aliquots are taken at a depth of 10 cm., the material in the chamber being stirred thoroughly each time at the beginning of the sedimentation period.

Sedimentation Velocity and Particle Size.

All decantation or pipette methods of determining size classes depend on the relation o fsettling velocity to particle size—and this relationship is not accurately known. The relationship most used is Stokes's, formula for the fall of a solid sphere in a viscuous fluid,

$$V = \frac{2}{9} g \frac{(d - d')}{\eta} r^2$$

where V is the settling velocity of a sphere of radius r and density d in a medium of density d' and viscosity η, under a gravitational acceleration or centrifugal force, g.

The international method arbitrarily fixed 8 hours as the time for a particle 2 μ in diameter to fall 10 cm. in water at 20° C. This is the value determined experimentally by Atterberg although he does not state the temperature. If Stokes's law holds, as it is assumed in determining settling velocities in other sizes, then fixing the relation between settling velocity and particle size is equivalent to fixing the density of the sail particles Assuming $d' = 1$, taking the values of the viscosity of water given in the international critical tables, and the above values for V and r, Stokes's formula gives 2.61 for the density of the soil particle 2 μ in diameter. That this settling velocity may not be very accurate is indicated by the fact that den-

Atterberg's settling velocities and Stokes's formula, range from 1.64 to 2.03.

Joseph and Snow use a settling velocity of 10 cm. in 7.5 honrs, which corresponds to an average particle density of 2.71. Most specific-gravity measurements of clay give values above 2.7 Robinson and Holmes have shown that the average chemical composition of soil colloid is quite different from the composition of the sand fraction. The higher specific gravity of tbe colloid may be due, then, either to difference in composition or to the change in density of water in the micrapores and in the surface films of high curvature and large total area, surrounding the particles. For purposes of mechanical analysis it is important to know not only the average density of the soil particle of diameter 2 μ, bnt also the character of the particle, whether it is a solid mineral grain or an aggregate, or whether it is a gel or has a gel coating. The particles are too small to permit the application of the usual petrographic methods.

There is also some uncertainty as to the validity of Stoke's law for such a large range of particle shapes and sizes. Millikan found it necessary to add a correction to Stokes's formula for spheres falling in a gas when the mean free path of the gas moleeules exceeded a small fraction of the diameter of the sphere. In applying Stokes's law to the settling of sludges, C. S. Robinson used the viscosity and density of the suspension instead of the solution and a coefficient other than 2/9 for the particle shape factor. It is proposed to study the relationship of settling velocity and particle size in tuhe near future. In the meantime it seems best to conform to the relationship used in the international method.

The average density of soil particles at any given size is chiefly a matter of academic interest if size fractions are expressed in terms of settling velocities, as recommended by G. W. Robinson rather than in terms of equivalent diameters. But in a method in which five separations are made by sieving and only two by settling velocities, and the results are for the use of field investigators, it seems preferable to bold to the concept of that particle size.

Joseph and Snow have shown that, for five sails, considerable variation in temperature, time, or depth of pipetting produces a higher negligible error in the determination of 2μ clay but that a higher relative accuracy is required for larger particles. It has been noticed in this laboratory that the higher the sedimentation velocity the more difficult it is to secure good checks from pipette sampling. One reason is that, after the suspension has been stirred, several minutes are required for the turbulent motion to die down and permit settling to proceed undisturbed.

Formerly when all material smaller than 100 μ was sieved into the sedimentation chamber, a pipette determination was made at 50 μ. The pipette was then fitted with a metal tip, closed at the bottom, and provided with six small equally spaced holes drilled horizontally throngh the wall of the tip near its lower end. This tip assisted greatly in securing good duplicates, but it was found preferable to make this separation with a finer sieve. The tip was then used in the determinations of clay and colloid in an effort *to secure a cross section of the liquid* at the desired depth. Observations on particles of lampblack indicated that a pear-shaped volume, with the tip near the bottom of the pear, was removed by this means. The results thus obtained were no more consistent than those obtained with the plain straight glass tip so that the removable tip was abandoned. According to Kohn, who has worked out the hydrodynamic principles involved, a pipette with any kind of tip, straight or bent, should remove a sphere of liquid whose center is the opening of the pipette tip. It is necessary that the rate of filling the pipette be high in comparison with the settling of the largest particles.

Outline of Method.

General Statement.

In view of the foregoing facts the writers desire to present a detailed method of procedure for carrying out the mechanical analysis of soils. This procedure is the one now used in the Bureau of Chemistry and Soils. It differs from the international method in certain particulars, viz., the omission of hydrochloric acid treatment, the method of filtering and washing, the drying and weighing of the sample after pre-treatment, the use of sodium oxalate as dispersing agent, the use of a finer sieve for wet sieving, and the fact that there is only a single transfer of the sample before separation into size classes. This procedure is more rapid and, it is believed more accurate than the international method.

Preparation and Dispersion of Sample.

The sample of soil for analysis is mixed with a large spatula, and is then quartered. The quarter reserved for analysis is rolled with a woden rolling pin to break up clods

and then is passed through a sieve with 2-mm. round holes. Care is taken in all mixing and quartering to see that the fine material on the paper is properly distributed. Samples are run in sets of eight.

Two samples of each soil are weighed out at the same time, a 10-gm. sample for analysis and a 5-gm. sample for moisture determination. The latter is dried at 105° C. for 16 hours, cooled in a desiccator, and weighed. The 10-gm. sample is put into a 250 c.c. Pyrex electrolytic beaker.

To the 10-gm. sample is added 40 c.c. of 6 per cent hydrogen peroxide, and the beaker is covered with a watch glass. The beaker is frequently shaken in order to bring all the organic matter in contact with the peroxide. When the reaction has quieted down more peroxide may be added where experience indicates that it is needed, and the beaker is placed on a slow steam bath overnight. Then if all organic matter does not appear to have been removed, more hydrogen of full strength (about 30 per cent.) is added. If manganese dioxide is known to be present or its presence indicated by decomposition of the hydrogen peroxide without removal of organic matter, then a small quantity of acetic acid is added. About 50 mg. of glacial acetic acid is usually sufficient for a soil containing 0.5 per cent. MnO_2. Repeated additions of small amounts of hydrogen peroxide appear to give best results. After decomposition of the organic matter the excess peroxide is boiled off.

If acid treatment is desired the sample is cooled and then treated with 10 c.c. of N HCl, made to a volume of 100 c.c. and allowed to stand overnight. If it is desired to remove all the carbonates, enough acid is added so that the concentration of acid in the beaker, after the carbonates are dissolved, will be 0.1 N. This really involves a prior determination of carbonates. In this laboratory, method B of the Association of Official Agricultural Chemists is used for carbonate determination.

The sample with or without acid treatment is now ready for washing. This is done by removing as completely as possible the solution from the sample in the beaker with a short Pasteur-Chamberland suction filter. The lower 12 cm. of the filter is sawed off, fitted with a removable stopper, and used for this purpose. The liquid is then removed from the hollow filter core and replaced with distilled water. By means of a rubber bulb back pressure is applied to the filter in order to remove adhering soil material. The sample is well stirred with 125 c.c. of distilled water and the solution again removed by filtration. Six such washings are usually sufficient. If it is desired to determine the quantity of dissolved oxides of iron and aluminium the washings from each sample are saved separately, made slightly alkaline with ammonia, and boiled. The precipitate is washed on a filter paper, dried, ignited and weighed.

After cleaning and removing the suction filter, the soil sample is evaporateed to dryness on a steam bath and then dried in an electric oven at 105° C. for 16 hours overnight). Upon cooling in a desiccator the sample, still in the beaker, is quickly weighed on a Chainomatic balance. If this weighing is done rapidly the sample will not take up more than 1 mg. of moisture. The sample is then soaked for a few minutes with about 25 c.c. of water, stirred with a rubber policeman, and transferred to a 250 c.c. nursing bottle. The beaker is again dried and weighed, the difference in weight being the proportion of the sample left after organic matter and solution loss. This is the portion of the sample upon which the percentage of size classes is based, when the results are used for textural classification. To the shaking bottle is added 10 c.c. of 0.5 N sodium oxalate, and the volume is made up to 150 c.c. It is shaken overnight on the reciprocating shaker described in Bureau of Soils Bulletin 84.

SEPARATION INTO SIZE CLASSES.

A sieve fitted with Tyler 300-mesh wire screen cloth is clamped above a 1-liter graduated glass sedimentation cylinder on foot, and the clay and finer silt are decanted from the nursing bottle, through the sieve, into the sedimentation cylinder. After a few pourings the clay is completely removed from the shaking bottle. The entire contents are then transferred to the sieve by means of a stream of distilled water. The cylinder is filled to the 1-liter mark with distilled water and set aside for sedimentation. Economical use of water is necessary in decantation and washing on the sieve, because the total volume of the silt and clay suspension is limited to 1 liter.

The sands and remaining silt may then be washed into a platinum dish and dried, but the preferred procedure is to set the wet sieve in a shallow aluminium dish, place in an oven to dry, and then transfer the dry sand and silt into the platinum dish. While the sands are drying, another sieve is used on the next sample. After drying for two hours at 105° C. the sands are cooled in a

desiccator, weighed, separated by a nest of graded sieves into size classes, and the weight of each class is determined. The *summation method of weighing the silt and* sands is used. The first sand is weighed, the second sand is added, the total weight determined, and so on. If the sum of the weight of fractions is equal to the total weight it is assumed that no error in weighing or recording weights has been made.

The material in the sedimentation cylinder is stirred with a motor-driven propeller and immediately the pipette is filled, before the coarser silt has had time to settle out. The pipette is emptied into a low-form glass covered weighing dish, and the washings from the pipette added. The time at which this stirring was made is noted. The time required for a particle 5 μ in diameter to settle 10 cm. is computed from Stokes's formula using a density of 2.61 and the viscosity of pure water for various temperatures (77 minutes at 20° C.). A curve is plotted with temperatures as ordinates and time as abscissae. At the time on the graph for the temperature, as read from a thermometer hanging in air near the cylinder, the suspension is again pipetted for clay. This time the pipette, clamped vertically to a support and with the stopcock closed, is carefully lowered by a rack and pinion until the tip is just 10 cm. below the liquid surface, as shown by a pointer moving over a fixed scale. In case pipetting can not be done at the correct time the additional depth required for any delay can easily be computed, time and depth being directly proportioned. This time the pipette is filled with an even suction in about 40 seconds, and the entire contents run into a weighing dish. The pipette is washed two or three times and the washings added to the dish.

Pipetting of the colloid is similar to that of clay except in this case settling time is fixed at six and a half hours, and a graph, computed from Stokes's law, giving the relation of depth to temperature is used.

If the room temperature changes rapidly the cylinders are covered with bakelite jackets, but in general room-temperature If there is a temperature difference between opposite sides of the cylinder there will be a circulatory movement of the suspension, a condition to be avoided.

Occasionally sets of separates are submitted to William H. Fry of this laboratory for microscopic examination by his methods. He usually finds the sands practically free from adhering colloid and the silts relatively free from colloidal aggregates.

CALCULATION OF RESULTS.

From the moisture determination of the 5-gm. sample, the dry weight of the sample *for analysis is computed. After peroxide* treatment, and acid treatment if used, followed by washing, the sample is dried and weighed. The difference between the two weights is the hydrogen peroxide-solution loss. The first dry weight, which includes organic matter and solution loss, is taken as the base for calculation of results except when the analysis is to be used for textural classification only. In the latter case the dry weight, after washing, is taken as the base.

From the weight of the first pipetted solu- aliquot, after deducting the weight of the dispersing agent, the dry weight of silt and clay in the sedimentation chamber can be determined directly. It can also be determined by taking the difference between the total weight of the dry sifted silt and sands. These weights should check, but in every case the weight directly determined by pipetting is slightly greater, varying from a small fraction to as much as 1 per cent. or more. The reason for this discrepancy has not yet been found. In routine analyses the dry weight of material in the sedimentation chamber is obtained by difference, but the amount is also determined by pipetting, and if the two results fail to check within 2 per cent. the analysis is repeated.

From the weight of the clay and colloid aliquots is deducted the weight of added sodium oxalate and the total amount of material smaller than 5μ and 2μ is computed No size class between these two limits is established. If the weight of clay is deducted from the total dry weight in the sedimentation cylinder the difference is silt. This is added to the amount of silt sifted from the *sands to give total silt.*

USE OF ELECTRICITY AT MINES.

The Secretary for Mines desires to draw attention to the publication of a new edition of the handbook of Explanatory Notes by H.M. Electrical Inspector of Mines on the general regulations governing the installation and use of electricity at mines under the Coal Mines Act, 1911.

This handbook is intended to serve as a practical guide to mine managers, electricians, mechanics and others in carrying out their duties under the regulations, in the choice of safe and efficient maintenance, and generally in the observance of those precautions which experience has shown to be necessary for the prevention of accidents.

BRITISH INDUSTRIES FAIR. LONDON, FEBRUARY 17 TO 28.

MESSRS. THE SOUTH METROPOLITAN GAS CO.
Stand Nos. B.52 and B.53.

The South Metropolitan Gas Company's display of the Metro Chemical Products comprises a large range of Inorganic and Organic Compounds, resulting from the manufacture and purification of Coal Gas and the distillation of Crude Coal Tar. A few of which might be mentioned are :—Road Tar to the British Ministry of Transport Specifications; Disinfectant Fluid approved by the Ministry of Agriculture; Metro Tar Oil Winter-wash, an emulsion of a specially selected "High Boiling" Tar Oil (the Oil used in its preparation being the same as that which has produced such satisfactory results in the trials on dormant fruit trees conducted by the Long Ashton Research Station). Creosote; Pyridine; Anthracene; Napthalene; Motor Benzole; Black Varnish; Light and Heavy Oils of various grades and characteristics, etc.

MESSRS. SPENCER CHAPMAN & MESSEL LTD.
Stand No. B.70.

The exhibit of this firm comprises the acids for which they are so well known, such as sulphur trioxide, oleum of strengths of 20, 40, 60 and 80 per cent., concentrated sulphuric acid, battery acid, hydrochloric acid and chemically pure nitric acid.

MESSRS. THOMAS TYRER & CO. LTD.
Stand N. A.184.

Thos. Tyrer and Co. Ltd., of the Stirling Chemical Works, Stratford, London, E.15, are showing the usual range of chemicals for which this firm is well known. Particular interest attaches to their exhibit of manganese, nickel, and cobalt products for use as paint driers, cadmium sulphide for the rubber industry, with various acids and aluminium stearate. Nickel formate, of which Tyrers are the only British makers, is chiefly used for the deposition of metallic nickel as a hydrogenation catalyst, for which the formate has been shown to be better than the oxalate.

The usual wide range of reagent chemicals is shown under the "Sterling" brand in the firm's special glass reagent bottles, in which form they are well known.

a MESSRS. WHIFFEN AND SONS, LTD.
the Stand No. B.80.

replac ssium Iodide, an article of great im-
a rubbe in Medicine and Industry, is shown
e filter est form obtainable. It has been
of the firm for nearly 100 years,
and has become a standard product amongst buyers all over the world. A recent addition to its many uses is a preparation for cattle food and a table of quantities with advice as to method of administration is obtainable free at the stand. Other important Iodine preparations are also shown.

Potassium, Ammonium, and Sodium Bromide, of which they claim to be the largest makers in the United Kingdom, are also standards of purity, an essential when required for medicinal or photographic purposes.

Another highly interesting exhibit is the Emetine Group, comprising Hypodermic tablets in various sizes, greatly in request for tropical countries. Their reliability and excellence have become well known. Australian and New Zealand buyers may see at the stand a range of Hulle's Strychnine ready packed in the usual popular sizes familiar to their markets. Hulle's Strychnine still remains the most efficient destructor of rabbit and other pests.

Salicin of which the firm was one of the earliest manufacturers is in great demand as a cure for influenza.

Vermilion is shown in some of the principal shades, but any variation can be matched.

Caffeine, Camphor, Clove Oil, Almond Oil, Sandalwood Oil and many other Pharmaceutical Products are on view.

A recent addition to the firm's activities is exhibited in the form of the New Health Food "Gelozone" a preparation of Carragheen (Chrondrus Crispus). It is a vegetable gelatinising agent valuable for the ease and speed with which it can be used. It possesses health giving qualities due to its Pectein, Protein and Iodine contents. Also shown as a preparation of Chocolate and of Milk Powder.

MESSRS. THOMAS MORSON & SON LTD.
Stand No. B.78.

Thomas Morson and Son, Ltd., exhibit a selection of Fine Chemicals used for pharmaceutical, laboratory, technical and toilet purposes.

The first group comprises :—Bismuth Salts, Bromides, Citrates, Glycerophosphates, Iodides, Kreosote and Scale Preparations.

The Laboratory Chemicals include :—Reagent Chemicals of high standard of purity for scientific purposes.

Amongst the technical section are found :—Light Sensitive Iron Salts for the manufacture of Blue Prints and Colour Photographs, etc.

While the toilet chemicals include :— " Osmo " Kaolin and Zinc and Magnesium Stearates.

A special feature is made of :—Lithium Salts and Morson's Soluble Kreosote known as M.S.K., prepared from certain fractions of Beechwood Kreosote and existing in the form of a light brown powder, free from smell and *soluble in water*. This is a " Natural " product, containing 50 per cent. by weight of Kreosol and Guaiacol Oils and may be used to advantage in the preparation of many specialities.

VERY HIGH STEAM TEMPERATURES.

MODERN ADVANCES IN SUPERHEATING.

By A Well Known Engineer.

Of great importance to the chemical and other industries is the rapid progress being made with superheater design and operation, so that temperatures of 750°—1,200° F. can now be used without appreciable troubles due to wear and tear and breakdown of the superheater. Some general applications for steam of this character are synthetic liquid fuels, oil cracking, low temperature carbonisation, and power plant operation, especially in conjunction with process and " boiling " steam at low pressures from pass-out turbiues. It is now being demonstrated, and particularly by the Superheater Company, Ltd., with their well known " M.L.S." single-pass, multiple-loop, design of superheater, that temperatures up to 850° F. can be operated with safety when using low carbon steel, if proper scientific methods of design and construction are adopted.

A number of such superheater installations are operating, or under construction, in Great Britain for temperatures above the 750° F. limit, one of the most striking examples being the plant at Synthetic Ammonia and Nitrates Ltd, Billingham-on-Tees, with steam at 840° F., one of the highest temperatures so far employed in industry, while also the I.G. Farbenindustrie A.G. in Germany are operating at 800° F. on the same lines. Efficient superheating at say 725°—850° F., especially with low carbon steel, is largely a matter of long experience and careful adaptation of the equipment to the individual conditions. Thus for example in the " M.L.S." high duty designs, the saturated steam always goes first through the section in the hottest gas zone, while the design for the " critical " velocity to be reached at the normal load of the boiler so that the difference in temperature between the metal and the steam will be at a minimum, whilst a maximum factor of safety is ensured. A vital matter also for conditions of 750°—850° F. is uniform distribution of the steam throughout all the elements under all conditions of loading, as by this alone can local overheating be avoided. The characteristic features of the design to ensure these conditions are the single-pass system, by means of a series of multiple loop elements the saturated steam header to the superheated steam header, the elements being made of lengths of pipe connected together by a special patented machine forging process, no screwed or welded joints being used. Also these integral forged return bends are thicker and stronger than the tubing itself. The reversal of the steam at the bends breaks up any central wet core, whilst correct velocity gives high temperature and scouring action so that any solids carried over are not deposited and continuous maximum heat transmission is ensured by eliminating scale formation unless the priming is excessive and the water very bad. Interesting also are the designs of superheating equipment for conditions say up to 1200° F., such as now used in low temperature carbonisation and various chemical operations which consist in constructing the superheater in two sections, first of ordinary low carbon steel, as above, to give say 850° F. followed by a special section of alloy steel to take the increase to 1200° F. or other figure.

SILVER PRODUCING MINES OF BRITISH COLUMBIA.

Native silver rarely occurs in British Columbia. Almost all of the metal produced in the Province is obtained from silver minerals associated with lead and zinc minerals or less frequently with copper or gold. Nearly every metalliferous mine contains some of the white metal but, with few exceptions, these mines are small and their commercial existence depends largely on their silver content.

British Columbia had in 1928 the record production of 10,600,000 ounces of silver, which is over 3 million ounces greater than that of Ontario, the next largest silver-producing Province. The production estimated for 1929 is only slightly less, being 10,400,000 ounces. The actual market value of this output is, however, considerably lower than that of the previous year, owing to the lower price of 53.1 cents as compared to 58.2 cents per ounce in 1928.

The largest silver producers in British Columbia are mines in which the silver content is low and the metal of only secondary importance, their high output being due to the large tonnage treated.

STUDIES ON VISCOSE. I. ANALYSIS OF BARIUM THIOCARBONATE.

By Kotaro Tanemura and Toshio Kohno.

Sodium thiocarbonate prepared by W. Mang's method (*Die Kunstseide*, 1925, VII, 277) and by the modified method of Professor Fukushima and his co-workers (*Cellulose Industry*, Japan, 1927, III, 214) is not pure. Barium thiocarbonate prepared by W. Mang's method is pure enough to test whether it can be determined by iodimetry or not. The method was compared with a zinc sulphate method proposed by E. Finet and A. Bertrand (Oscar Kausch, *Der Schwefelkohlenstoff*, 1929, 60) and the formalin method.

0.8191 g of barium thiocarbonate was dissolved in distilled water and was filled up to 500 cc. and was tested by the following three methods.

(1) *Zinc sulphate method.* The theory of this method is as follows: Zinc sulphate reacts with barium thiocarbonate forming barium sulphate and zinc thiocarbonate and the latter decomposes quickly at 50-60° C. into zinc sulphide and carbon disulphide. The apparatus was weighed before and after the reaction and carbon disulphide was obtained as the difference.

Sample taken 50 cc. of the above solution.	
Weight before the reaction	184.5682g
Weight after the reaction	184.5410g
Carbon disulphide	0.0272g

By this method carbon disulphide in 0.8091g of barium thiocarbonate is 0.272g.

(2) Iodimetric method. 50 cc. of the above solution was neutralised with 0.1 N acetic acid with the indicator of phenolphthalein. The solution was titrated with 0.1 N iodine solution with starch solution as the indicator and 0.7 cc. were required. Assuming the reaction between barium thiocarbonate and iodine as $BaCS_3 + 2I = BaI_2$ $CS_2 + S$, 1 cc of 0.1 N iodine solution corresponds to 0.0038g of carbon disulphide. By this method 0.8091 g of the sample correspond to contain 0.266g of carbon disulphide.

(3) *Formalin method.* 10 cc. of the above solution was taken and neutralised with 0.1 N acetic acid. The alkali developed by the addition of 40 cc. of neutralised formalin was titrated with 0.1 N acetic acid and 1.4, 1.35 cc. were required. In all cases phenolphthalein was used as the indicator. The consumption was just equivalent to that of 0.1 N iodine solution and so one molecule of barium hydroxide must be formed in place of one molecule of barium thiocarbonate. Then 1 cc. of 0.1 acetic acid corresponds to 0.0038g of carbon disulphide. By this method 0.8091g of the sample contains 0.262g of carbon disulphide.

Theoretical quantity of CS_2 in 0.8091g of the sample	0.251g
Zinc Sulphate method	0.272g
Iodimetric method	0.266g
Formalin method	0.262g

Summary.

Barium thiocarbonate can be obtained in purer state than sodium thiocarbonate and so it was selected as the representative of thiocarbonates. The result of the analysis by (1) zinc sulphate method, (2) iodimetric method and (3) formalin method was compared and the fact that 2 atoms of iodine react with the molecule of thiocarbonate and accordingly thiocarbonates are determined by iodimetric method was ascertained.

A SIMPLE HYPOTHESIS WITH REGARD TO THE PARTITION COEFFICIENT EXISTING IN TERNARY LIQUID SYSTEMS.

By Rowland Marcus Woodman.

Errata.

Owing to the non-arrival of proofs in time at the printers, the following errors were made in the printing of the above paper:—

P. 18, line 48: For "d_4 and d_3," read "d_1 and d_2."

P. 18, line 51: For "c_1/c_2" read "c_1^n/c_2" and for "$c_1/\sqrt{c_2}$" read "$c_1/\sqrt[n]{c_2}$"

P. 19, text, line 10: For "c_5/c_7" read "c_5^2/c_7"

P. 20, Table: Column headings 15, 17 and 18 should be, respectively, "$c_5^4/c_6 \times 10^2$", "$c_6^2/c_5 \times 10^3$" and "$c_6^3/c_5 \times 10^4$"

P. 21, 2nd Table: Column heading 8 should read "$c_3^2/c_4 \times 100$"

P. 21, Text, line 21: For "c_4/c_4" read "c_3/c_4."

P. 22, Table: Column heading 16 should read "$c_6^5/c_5 \times 10^5$"

P. 22, Text, line 27: Should read "c_6^2/c_5, c_6^3/c_5 and c_6^4/c_5"

Civic enterprise in industrial development is represented at the British Industries Fair by such exhibits as those of the cities of Hull and Widnes, both of considerable importance as the centres of large chemical industries.

GENERAL NOTES.

HIGHER TEMPERATURE FOR SUPERHEATING.

It has generally been the opinion that over 750° F. temperature is impracticable for superheating because of the steel, but this has now been proved to be incorrect, and there are a number of boiler and power plant installations running to-day with temperatures between 750-1,000° F. Also there are low temperature carbonisation plants in which steam is used at 1,200° F., and the subject is certainly a highly interesting one. The subject is ably dealt with in another column by "A Well-known Engineer."

BRITISH STANDARD PLUGS AND SOCKETS.

A revision of British Standard Specification No. 196 has just been issued by the British Engineering Standards Association, and, although the differences between the new (1930) and the 1927 editions are small, they are of interest from the manufacturing point of view. One of these differences relates to the dimensions of the lug on the non-reversible plug and socket.

SCIENTIFIC RESEARCH IN THE EMPIRE.

A lecture on "Scientific and Industrial Research in the British Empire" was given by Mr. Arthur W. Hill, C.M.G., Sc.D., F.R.S., Director of the Royal Botanic Gardens, Kew, at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, on Tuesday, February 25.

Lieut.-General Sir William Furse, K.C.B., D.S.O., Director of the Imperial Institute presided.

FRENCH TRADE IN 1929.

Imports into France last year showed an increase in value of about 9 per cent., but exports from that country declined rather more than 2½ per cent. The adverse balance of trade on the year increased to 8,212 million francs from 2,061 millions for 1928.

We have received from Messrs. Garner & Peeling, Golden Square, W., a copy of the Zeiss Ikon brochure which deals especially with cameras for press work. A copy will be sent gratis on application to the above agents.

GAS MASKS FOR MINES.

Thet use of gas masks for respiratory protection against poisonous gases in industrial processes has been gradually increasing during the past ten years, their development having been advanced by the impetus given by war-time requirements; but for mine rescue purposes the self-contained breathing apparatus, carrying its own supply of oxygen or air, has been the only reliable protection from poisonous gases available in this country.

With the discovery of hopcalite, a specially prepared mixture of manganese dioxide and copper oxide which converts carbon monoxide into carbon dioxide, it has become possible to make gas masks which give protection against afterdamp, provided there is sufficient oxygen present in the air to maintain life, and in the United States a gas mask, the "All Service" mask, has been approved by the Bureau of Mines and has been used in mine rescue work with considerable success.

Close co-operation is maintained between the British Safety in Mines Research Board and the United States Bureau of Mines under a scheme which provides both for the carrying out of joint researches and for the exchange of investigators who are specially skilled in particular subjects. Under this scheme Dr. S. H. Katz, chemist-in-charge of the Bureau of Mines gas mask Laboratory came to this country in April, 1928, and for just over a year joined with a member of the Research Board's staff in carrying out investigations in the Board's laboratories at Sheffield with the object of designitng a mask which would be as efficient as the "All Service" mask but would offer appreciably less resistance to breathing.

An account of these researches is now published by the Safety in Mines Research Board under the title of "Mine Rescue Apparatus: The S.M.R.B. Gas Mask," by S. H. Katz and C. S. W. Grice (S.M.R.B. Paper 57, H.M. Stationery Office, price 9d. net). The paper appears to show the possibility of the introduction of a light gas mask to take the place of self-contained breathing apparatus in support work during mine recovery operations, if not in pioneering work.

Although the mask was designed primarily for mining purposes, it is hoped that it may prove suitable for the use of firemen and other workers who are liable to encounter poisonous gases in the course of their occupation.

THE SCIENTIST'S REFERENCE BOOK AND DIARY FOR 1930.

Messrs. James Woolley and Co., of 76, Deansgate, Manchester, issue once more the above useful book, which as usual is full of useful information. The first section is in the main, a diary and memorandum book, the second and larger section being devoted to useful scientific facts, tables, etc.

DISTRIBUTION OF OUR TRADE IN 1929.

The value of imports into the United Kingdom from British countries last year amounted to 26.12 per cent. of the total, compared with 27.00 per cent. in 1928 and 24.87 pjer cent. in 1913. The value of exports of home produce to British countries was 41.00 per cent. of the total, against 47.96 per cent. in 1928 and 37.18 per cent. in 1913.

CAPITAL ISSUES IN CANADA.

Over a thousand million dollars is reported to have been raised in Canada last year by means of new capital issues. Great Britain supplied 9 per cent. and the United States 30 per cent.

KEY INDUSTRIES.

BOARD OF TRADE ANNOUNCEMENT.

Representations have been made to the Board of Trade under *Section 10 (5) of the* Finance Act, 1926, regarding Adipic acid and oxymethyl para oxyphenyl benzylamine methyl sulphate.

Section 10 (5) of the Finance Act, 1926, is as follows :—

" The Treasury may by order exempt from the duty imposed by section one of the Safeguarding of Industries Act, 1921, as amended by this Act, for such period as may be specified in the order, any article in respect of which the Board of Trade are satisfied on a representation made by a consumer of that article that the article is not made in any part of His Majesty's Dominions in quantities which are substantial having regard to the consumption of that article for the time being in the United Kingdom, and that there is no reasonable probability that the article will within a reasonable period be made in His Majesty's Dominions in such substantial quantities."

Any communication should be addressed to the Principal Assistant Secretary, Industries and Manufactures Department, Board of Trade, Great George Street, S.W.1., within one month from the date of this notice.

BRITISH IRON AND STEEL OUTPUT.

An increase of 7,000 tons over the previous month in the production of pig iron in January was accompanied by a reduction of three in the number of furnaces in blast. The output was 86,000 tons above that of January, 1929. Production of crude steel recovered well from the December setback and was slightly larger than twelve months earlier.

EARLY CANADIAN FOREST FIRE PATROLS.

The Forest Service of the Department of the Interior has found that by the use of aircraft equipped for winter flying, it is now possible to commence the patrol of forest areas in Manitoba and Saskatchewan in March instead of late May, as formerly. In this way fires started by trappers, prospectors, and others, during the winter months are detected and reported, and means taken for their suppression before they attain serious proportions.

CORROSION OF LEAD IN BUILDINGS.

The results of some investigations into the corrosion of lead in buildings are summarised in a Building Research Bulletin recently issued by the Department of Scientific and Industrial Research.

Particular attention is paid to methods for preventing possible decay of the metal when it is used in contact with cement or lime mortar or plaster, with timber or with soil. The Bulletin should be of considerable interest to architects, builders and plumbers.

Messrs. Chance Brothers of Birmingham, have sent us a report on the examination of their " Improved Resistance " Glassware by the National Physical Laboratories. From the various tests applied (and given in the report) the resistance of the glassware to chemical reagents " is good, especially in the case of water, acid and ammonia. The attack by caustic alkali is, however, high, but considering the severe conditions imposed it is not excessive. The behaviour of the glassware under the various tests may be regarded as very satisfactory . . . The thermal endurance of the present samples also shows a definite advance on those previously tested. In regard to uniformity of weight, thickness and shape, the samples submitted are very satisfactory."

AT BRITISH INDUSTRIES FAIR OLYMPIA (LONDON).

The Burroughs Wellcome and Co. display embraces a comprehensive series of fine chemicals, galenicals and other pharmaceutical products.

A striking display of crystals introduces a novel feature to the exhibit. Chemists cannot but be impressed by the exquisite form and variety of the crystals, which provide an object lesson in crystallography. In the majority of cases the crystals are displayed as they actually separate from solution. In other instances, individual crystals indicate the form in which they grow under ideal culture. Amongst the organic chemicals are included several in brilliant colours and shapes of great beauty. A particularly interesting exhibit is crystalline insulin prepared at the Wellcome Chemical Works from the insulin hydrochloride used in the preparation of " Wellcome " Brand Insulin.

Prominent among the chemicals are " Wellcome " Brand Bismuth Carbonate, and Sodium Salicylate. The former salt, which contains less nitrate and less alkali carbonate than the ordinary pharmacopoeial salt, is aptly described as " Better than B.P." The latter is issued in powder and in flake and forms a bright and colourless solution in water (25 per cent.). Both varieties of sodium salicylate slide easily into the bottle—an undoubted advantage in dispensing.

In view of the instability of the majority of digitalis preparations, it is important to mention that " Diginutin," a solution of the total glucosides of digitalis leaves freed from inert vegetable matter, is quite stable and may be used with advantage in place of the tincture.

The desirability of using exclusively the laevo-rotatory natural ephedrine alkaloid in asthma, hay-fever and other bronchial conditions is now admitted. Burroughs Wellcome and Co. have invariably used the laevo-rotatory alkaloid when preparing their ephedine products.

A display of " Kepler " Malt Extract (an important source of Vitamin B) and " Kepler " Cod Liver Oil with Malt Extract, (in which active Vitamins A, B and D are presented in their natural form and association) helps to remind visitors that the reputation of " Kepler " products was established many years before vitamins were discovered and it is satisfactory to note that a scientific explanation of their therapeutic efficiency has been accepted.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, February 20.

The following papers were read :—

Critical Potentials for the Excitation of Soft X-rays from Iron. By A. C. Davies, F. Horton, F.R.S., and E. Blundell.

The paper discusses the failure of results of investigations of critical potentials for excitation of soft X-rays from solids, and for production of secondary electrons from solids, under electronic bombardment, to conform with the view that characteristic displacements take place of electrons forming the outermost extranuclear groups in the bombarded atoms.

The significance is emphasised of the apparent lack of any connection between these critical potentials and velocity distribution results for secondary electrons and photo-electrons emitted by soft X-rays, and the desirability is stressed of investigating any possible connection between critical potentials and physical condition of the target surface.

The experiments deal with critical potentials for soft X-ray excitation from iron, rolled into thin strip from a drawn wire, for different temperatures and also for the same specimen at room temperatures, after being subjected to various heat treatments.

The critical potentials for the strip in its original condition showed very satisfactory agreement with the values previously found for iron by Andrewes, Davies, and Horton. The treatment to which the strip was subjected produced many additional critical potentials, mostly persisting throughout the subsequent conditions of the target, once they had made their appearance. Only one critical potential—at 201 volts—justifies the conclusion that its presence was dependent upon the iron strip being at a high temperature. Apart from this, the results suggest no connection between critical potentials and temperature as such.

The Absorption of Light by Chlorine Bromine and their Gaseous Mixtures. By L. M. T. Gray and D. W. G. Style. Communicated by A. J. Allmand, F.R.S.

The independence of the absorption of chlorine of the intensity or nature of the incident radiation was tested by the following methods—

(1) Change of intensity by (*a*) change of position in a divergent beam; (*b*) wire screens.
(2) Photographs using (*a*) iron spark; (*b*) quartz mercury arc.
(3) Photographs of light transmitted by chlorine when illuminated simultaneously by spark and arc.

No variation of extinction coefficients was found.

Extinction coefficients of bromine vapour have been determined at room temperature for mercury-arc lines between $240\mu\mu$ and $579\mu\mu$. Absorption below $334\mu\mu$ is small, being at a minimum between $310\mu\mu$ and $300\mu\mu$, below which it rises slowly.

The behaviour of a commercial light filter containing chlorine and bromine, whose transmission depended upon the manner in which measurements were made and upon the time for which it had been insolated, is discussed from the point of view of the existence of the compound BrCl in the vapour phase and its photo-decomposition. Mixtures of these gases of known composition were made up and their absorptions measured. Results confirmed the eyistence of BrCl, enabling its extinction coefficients to be calculated for wave-lengths shorter than $300\mu\mu$.

THE CHEMICAL SOCIETY.

Thursday, February 20.

The Properties of the Chlorides of Sulphur. Part II. Dielectric Constants. By T. M. Lowry and G. Jessop.

The dielectric constants of sulphur and chloride mixtures have been measured over the range of composition from monochloride to chlorine, and from room temperature down to the freezing-points.

The isothermals for the liquids confirm the existence of sulphur dichloride, but do not show any inflexion corresponding with the tetrachloride, even at −50°.

The dielectric constant of the solids shows a pronounced maximum at the composition of the tetrachloride.

The Properties of the Chlorides of Sulphur. Part IV. Density and Surface Tension. By T. M. Lowry and G. Jessop.

The densities of equilibrium mixtures of the chlorides of sulphur have been measured at temperatures between −4° and +30°, and of the range of composition from 37 within per cent. of chlorine to pure liquid notice. The surface tensions of the same mixtures have been measured at room temperature and at 0°. Measurements of density and surface tension have also been made with mixtures of uncombined sulphur monochloride and chlorine, in which the red colour of the dichloride had not yet developed.

The density and the surface tension show a slight discontinuity at the composition of the dichloride, but nothing of this kind was observed at the composition of the tetrachloride. The densities and surface tensions of uncombined mixtures of sulphur monochloride and chlorine are less than after combination has taken place.

Mixtures of uncombined sulphur monochloride and chlorine show a parachor-deficiency which is greatest at about 75 atomic per cent. Cl., since the curve is approximately symmetrical. This deficiency is reduced by about 60 per cent. after combination to form the dichloride, when the single loop of the parachor-curve is replaced by a double loop. The increase of the parachor on combination rises to a maximum at the composition of the dichloride, but there is no similar indication of the formation of a tetrachloride.

Trypanocidal Action and Chemical Constitution. Part IX. Aromatic Arsinic Acids Containing an Amide Group. By G. A. C. Gough and H. King.

Durring and Reid showed that a series of dyes produced by coupling diazotised *p*-aminophenylstibinic acid with naphthylaminesulphonic acids were trypanocidally active. An unsuccessful attempt was made to prepare colourless analogues of these possessing trypanocidal activity. In searching for some explanation of the lack of activity of such colourless products it was found that benzamide-*p*-arsinic acid had a chemotherapeutic index more favourable than that of atoxyl, the starting point of Ehrlich's series of arsenicals. As this was the first benzamidearsinic acid to be described, a wide field was opened for development. A large number of substituted benzamidearsinic acids have now been prepared, and from a consideration of the constitution and trypanocidal activity of these certain general conclusions are reached.

Strychnine and Brucine. Part X. The Degradation of Dinitrostrycholcarboxylic Acid; Its Recognition as a Derivative of Quinoline and the Consequent Modification of the Constitutional Formulæ for the

Strychnos *Bases Proposed in Part VII*. By K. N. MENON, (the late) W. H. PERKIN, JUNR., AND R. ROBINSON.

Tafel's dinitrostrychoicarboxylic acid has been degraded to picric acid and to dinitroisatin so that there is no longer any reason to doubt that the substance is a quinoline derivative. In view of the exclusion of the possibility that strychol is 2 : 4-dihydroxyquinoline (Part IX) it is clear that strychol must be 2 : 3- or 3 : 4-dihydroxyquinoline, and the former is considered the more probable of the two alternatives.

Clear evidence bearing on this last point has not been adduced, but the implications in regard to the constitution of strychnine are not very different.

Brucine is derived from strychnine by the introduction of methoxyl groups in the positions indicated.

GEOLOGICAL SOCIETY OF LONDON.

ABSTRACT OF REPORT OF THE COUNCIL FOR 1929.

During the past year 48 new Fellows were elected into the Society (5 more than in 1928), and 3 were reinstated. Of the Fellows elected in 1929, 35 paid their Admission Fees before the end of that year, and, of the Fellows who had been elected in the previous year, 12 paid their Admission Fees in 1929, making the total accession of new and reinstated Fellows during 1929 amount to 50 (3 more than in 1928).

The Society has lost during the year 51 Fellows (24 deceased, 12 resigned, and 15 removed for non-payment of their Annual Contributions). The total number of Fellows is now 1282 (1 less than in 1929), made up as follows :—Compounders, 166; Contributing Fellows, 1107; and Non-Contributing Fellows, 9.

With regard to the Lists of Foreign Members and Foreign Correspondents, vacancies were filled in 1929 by the election of 4 Foreign Members (Prof. C. Schubert, Prof. W. Vaughan) and 6 Foreign Correspondents P. Termier, Dr. E. O. Ulrich, and Dr. T. (Prof. O. Abel, Dr. C. N. Fenner, Prof. O. Holtedahl, Dr. R. Staub, Dr. V. K. Ting, and Prof. C. Wiman). The Council regrets on the other hand, to have to announce the decease of 1 Foreign Member (Prof. A. P. Pavlov) and of 3 Foreign Correspondents (Prof. O. Jaekel, Prof. C. Depéret, and Dr. D. de Cortázar).

The receipts credited during the year to the General Account, including £98 transferred from the Sorby and Hudleston Bequests Account, and a Bequest from the late Dr. C. Du Riche Preller of £100, amounted to £4,592 5s. 11d., making, with the balance brought in (£95 1s. 9d.), a total of £4,687 7s. 8d. The payments debited to this Account, included the purchase with the Preller Bequest of £98 2s. 11d. 5 per cent. War Stock at a cost of £99 19s. 2d., and the transference of £150 to the Maintenance Fund Account, amounted to £4479 7s. 9d., leaving a balance in hand at the close of the year of £207 19s. 11d. The Maintenance Fund opened with a balance brought in of £141 18s. 2d., and £150 was transferred thereto from the General Account, making, with the deposit interest received (£5 14s. 8d.), a total of £297 12s. 10d The payments charged to that Account amounted to £166 0s. 2d., leaviug a balance in hand of £131 12s. 8d.

An Income Tax Committee was appointed consisting of the President, the Treasurer, Mr. R. S. Herries, Mr. H. W. Monckton, and Prof. W. W. Watts, to submit to the Inland Revenue Claims Department the Society's case for the recovery of Income Tax, which had been levied during 1926-27 and 1927-28. Their representations were successful, and the thanks of the Council were voted to the Accountant, Mr. W. B. Keen, in appreciation of his services in the matter.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

Proteins. XI. Gliadin in Different Forms of Wheat. By KINSUKE KONDO AND TSUNETOMO HAYASHI.

Alkaloids in Aconitum. V. Mesaconitine and Hypaconitine, New Alkaloids Contained in the Plants of Aconitum. By SHIN-ICHI MORIO.

Molecular Refraction of Furan Derivatives. I. Molecular Refraction of α-Furan Derivatives. By ITIZO KASIWAGI AND SHIGEHIRO ABE.

Sulphide Acids. III. Normal Propyl Ether of Thioglycolic Acid. By YOSHISUKE UYEDA.

Influence of Temperature on Reaction Velocity of Thermal Polymerisation of Acetylene Gas in Presence of Nickel Catalyst. By KURAZO FUKAGAWA.

Reaction Velocity Between Sulphur Dioxide and Hydrogen Sulphide. By HITOSHI TOMINAGA AND SEIBI TORAISHI.

Iridium. IV. Isolation of Aquo-pentachloriridous Acid. By EIJIRO OGAWA.

Iridium. V. Vapour Pressure of Saturated Aqueous Solution of Sodium-hexachloriridite and its Solubility. Add. Vapour Pressure of Saturated Aqueous Solution of Sodium-hexachloroiridate. By EIJIRO OGAWA.

X-Ray Studies on Acidic Clay. I. 1. Observations with X-Ray on Various Samples of Acidic Clay. 2. Crystal Structure of Acidic Clay (Section I). By HAJIME ISOBE AND TOKUNOSUKE WATANABE.

Action of Superheated Water on Sugars. I. By SHIGERU KOMATSU AND CHOJI TANAKA.

Action of Superheated Water on Sugars. II. By CHOJI TANAKA.

Influence of Antitoxidants on Oxidation of Unsaturated Fatty Oils. I. By BUNNOSUKE YAMAGUCHI.

THE OPTICAL SOCIETY.

(Abstract of Address by the President of the Optical Society, at a meeting held at the Imperial College of Science and Technology, South Kensington, on Thursday February 13th, 1930).

"Optics," which originally meant the science which treats of light and the phenomena of vision, has by general consent come to include the phenomena of infra-red and ultra-violet radiation. The time is now ripe for a further extention to include other radiations, such as those used in radio transmission and the X-rays. Not only does the propagation of all these radiations follow the same laws, but the manifestations of them which have become of interest in recent years are often of a nature long familiar to those dealing with optics. Furthermore, some of the recent developments have resulted from the application of minds trained in optics to consideration of these other radiations.

Illustrations include the polarisation and interference of radio waves, the latter phenomenon enabling the height of the Heaviside layer to be determined; while the use of the notions associated with the diffraction grating have resulted in novel suggestions for beam radio transmission.

The "optical" phenomena of X-rays include the formation of characteristic spectra of the elements by the use of a crystal in a manner closely analogous to that in which the well-known optical spectra are produced by means of a diffraction grating.

The production of Aston's Mass Spectra, in which atoms of varying mass are distributed, and photographically register their position in a "spectrogram," was also dealt with.

NOTICES OF BOOKS.

Bacterial Metabolism. By MARJORY STEPHENSON, M.A. Pp. xii + 320. London: Longmans, Green & Co. 1930. Price 18s.

Fermentation processes have been known to man from the earliest times and must have been the object of much speculative enquiry even before the advent of any exact scientific knowledge. Alchemists like van Helmont, and early microscopists like Leeuwenhock, made certain definite observations before the fungi and bacteria associated with fermentation became the object of more exact study at the hands of Pasteur. Contributions to our knowledge of these organisms and their biochemical significance were made by Liebig, Traube, Naegeli, Berthelot, Cagniard, de la Tour, Buchner, and more recently Rubner. The views of Rubner and his school provide the starting point for Miss Stephenson's valuable monograph on "Bacterial Metabolism."

Her aim has been to "choose from the mass of data on the chemical activities of bacteria, facts which may help us to gain an insight into the essential chemical processes accompanying the life of the organisms concerned." After an account of the respiration and growth and nutrition of these organisms, their function in breaking down and in synthesising carbohydrates is discussed. Protein breakdown and the fixation of nitrogen and the autotrophic bacteria are also described in detail. There is an extensive bibliography and it is evident that much thought has been bestowed upon this presentation of the views current in the biochemistry of micro-organisms.

DR. FRANCIS ARNALL.

We regret to announce that the name of Dr. Francis Arnall must be added to the list of those who have lost their lives in the pursuit of chemistry. In carrying out an experiment on February 7 last, Dr. Arnall was holding a sealed "Carius" tube when it exploded and he died from wounds and shock four hours afterwards in Cardiff Hospital. Arnall, who had a brilliant career, was a Fellow of the Institute of Chemistry and of the Chemical Society to whose *Transactions* he had contributed several papers. He was also the author or joint author of some well known textbooks. Before he became Head of the Chemistry Department of Cardiff Technical College at the early age of 32 only two years ago, he was a lecturer in organic chemistry at Chelsea Polytechnic.

Forthcoming Events.

SOCIETY OF PUBLIC ANALYSTS.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society will be held on Wednesday, March 5, at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1., at 8 p.m.

The Accounts for the year will be presented, the President will deliver his Annual Address, and the election of Officers and Council for the ensuing term will take place. The appointment of Auditors will be made.

The Ordinary Monthly Meeting of the Society will be held immediately following the Annual General Meeting, when the following papers will be read :—

(1) " The Spectroscopic Investigation of Jams and the like."

(2) " A Simple Polarimetric Test for Sugars in Jams."

(3) " A New Kjeldahl Distillation Apparatus." By S. Judd Lewis, D.Sc., F.I.C.

" The Detection and Identification of Alkaloids in the Saliva and Salivary Glands." By Professor M. S. Eldin Bey, B.Sc.

ROYAL AGRICULTURAL SOCIETY.

SHOW AT MANCHESTER, TUESDAY, JULY 8, TO SATURDAY, JULY 12, 1930.

The Royal Agricultural Society of England has now issued the Prize Sheet for Live Stock, Poultry, Produce, Implements, etc., at the Show of the Society to be held at Manchester, from Tuesday, July 8, to Saturday, July 12. The total value of the Prizes offered (inclusive of Champion Prizes, Special Prizes, Challenge Cups and Medals) is £15,690, of which £1,503 represents contribution from the Manchester Local Committee, £3,434 from various Breed Societies, and £2,213 from other sources.

In the event of the average Entries per Class throughout the Section of any Breed falling below Four and/or the number of different Exhibitors throughout the Section being less than Four, the Classification for that Breed shall be cancelled automatically for the year, and the entry fees returned.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, London, W.C.2.

Monday, March 3, at 8 p.m.—Cantor Lecture. "Recent Improvements in Methods of Brickmaking." (Lecture III.) By Alfred B. Searle.

Wednesday, March 5, at 8 p.m.—Ordinary Meeting. " Brewing as a Branch of Science." By Arthur R. Ling, M.Sc., F.I.C., Professor, School of Malting and Brewing, and Department Biochemistry of Fermentation, University of Birmingham. Sir William Waters Butler, Bt., F.C.S., Past President of the Institute of Brewing, will preside.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Monday, March 3, at 5 p.m.—General Meeting.

Tuesday, March 4, at 5.15 p.m.—"X-Ray Determination of the Structure of Cellulose." By Sir William Bragg, F.R.S.

Thursday, March 6, at 5.15 p.m.—"Some Problems of Genetics." By J. B. S. Haldane.

Saturday, March 8, at 3 p.m.—" Atomic Nuclei and their Structure." Sir Ernest Rutherford, F.R.S.

UNIVERSITY COLLEGE, LONDON.

Thursday, March 6, at 5.15 p.m.—" Chemistry of Muscle in Relation to Problems of Cellular Physiology." First of a course of four public lectures by Professor Otto Meyerhof, Director of the Institute of Physiology, Kaiser Wilhelm-Institut, Berlin. March 6, 7, 10, and 12. (Lantern illustrations.)

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

2,816.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of azo dyestuffs. January 27.

2,823.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of azo dyestuffs containing chromium. January 27.

2,950.—I. G. Farbenindustrie Akt.-Ges. — Manufacture of N-substituted benzimidazolone - arsinic acids. January 28.

3,215.—Manufacture of vat-dyestuffs containing sulphur. January 30.

2,782.—Imperial Chemical Industries, Ltd.—Production of hydrocyanic acid. January 27.

Specifications Published.

294,113.—Battig, R.—Feneration of hydrogen.

299,331.—Soc. of Chemical Industry in Basle.—Manufacture of azo-dyestuffs and intermediate products.

Abstract Published.

322,824.—Dyeing.—Imperial Chemical Industries, Ltd., Millbank, London, and Brightman, R., Crumpsall Vale Works, Blackley, Manchester.

Regenerated celluloses, dyeing.—Viscose rayon is dyed in level blue and violet shades with the dyestuffs obtained by tetrazotizing and combining 4 : 4'-diaminodiphenylamine or a derivative thereof with a 2-amino-8-naphthol sulphonic acid or a derivative thereof (2 mols.) or with a 2-amino-8-naphthol sulphonic acid or a derivative thereof (1 mol.) and another component (1 mol.). Instead of 2-amino-8-naphthol sulphonic acids phenyl-J acid may be used. In an example rayon is dyed with the dyestuff *4-4'-diamonodiphenylamine* $\rightarrow$ 2 : 8 : $\rightarrow$ 6-acid (2 mols.) from a bath containing Glauber salts and soap; borax or sodium carbonate may also be added. In a table other coupling components specified are salicylic acid, phenyl-J acid, N-benzoyl 2 : 8 : 6-acid and 1-naphthol-4-sulphonic acid and as diazo component, 4 : 4'-diaminodiphenylamine-2-sulphonic acid. The coupling is made in alkaline solution in all cases. Specifications 280,320 and 281,410 are referred to.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

SHIRLAN.

506,916.—A chemical substance for preventing mildew on textile materials, paper, wood, leather and the like articles in the course of manufacture.—British Dyestuffs Corporation, Ltd., Imperial Chemical House, Millbank, London, S.W.1. February 5.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

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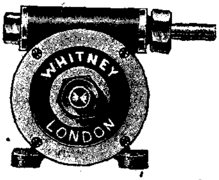

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NOTICE TO AUTHORS AND CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

CONSIDERATIONS SUR LA STRUCTURE DU NOYAU DE L'ATOME.

PAR CHARLES JANET.

Tout les atomes sont composés, uniquement, de ces deux éléments primordiaux, qui ont reçu des dénominations d'électron et de proton.

Nous représentons, dans ce qui suit :

l'électron, par le symbole e,

let proton, par le symbole p.

Les électrons et les protons étant les éléments primordiaux des atomes, sont, par conséquent, aussi, les éléments chimiques, des corps purs, simples ou combinés, et des corps complexes, mélanges ou assemblages de corps purs.

Ces deux entités sont donc, en somme, les éléments primordiaux de la Matière et de ses plus vastes accumulations, les Astres et les groupes d'Astres. Ce sont, en dernière analyse, les éléments primordiaux de l'Univers.

On assimile, en général, l'électron, et aussi le proton, à une particule, à un corpuscle, à un grain. Ces assimilations, ont pour but de bien indiquer, le caractère quantique, ou caractère d'invisibilité, des deux entités en question.

On n'est, peut-être, pas très éloigné de la réalité, en caracrisant l'électron et le proton de la manière suivante.

L'électron est un point singulier de l'Ether, point autour duquel l'Ether se différencie en un champ de lignes de force. Ce champ comporte de défomations rythmiques, en sorte que l'électron est une entité pulsatile. Ce champ, dont la nature est dite électrique, présente un sens, conventionnellement considéré comme négatif.

Le centre de l'électron pulsatile décrivant toujours, une trajectoire avec une vitesse variable v, il en résulte qu'il y a à considérer sur cette trajectoire, rectiligne, ou orbitale, ou autre, une longuer d'onde λ et une fréquence ν, variables, reliées par la relation $\lambda \nu = v$.

Par suite du mouvement de l'électron, un champ magnétique, variable, accompagne son champ électrique constant.

L'électron présente une résistance à toute cause qui tend à changer sa vitesse. Il possède, par conséquent, une inertie ou masse non gravifique, qui est environ 1847 fois plus petite que la masse, presque entièrement gravifique, du proton, dont il sera ...stion, plus loin. La masse de l'électron, ...t pas de nature gravifique, est inapte ...uire par un poids.

L... ayant un mouvement de rotation ... mouvement de translation, présente des caractères cinétiques que varient suivant les apports d'énergie supplémentaire qu'il peut recevoir et les livraisons d'énergie disponsible qu'il peut fournir.

L'intensité du champ électrique, de l'électron, est constante, en sorte que l'électron constitue l'unité indivisible, ou quantam, de charge électrique. C'est la charge électrique élémentaire, ce que l'on appelle, parfois, le grain d'électricité.

La valeur absolue, e, de ce quantam d'electricité, a été mesurée par R. A. Millikan. Elle est :

1. en unités électrostatistiques :
   $e = 4{,}774.10^{-10}$ u. e. s. de quantité;
2. en unités électro-magnétiques :
   $e = 1{,}591.10^{-20}$ u. e. m. C. G. S. de quantité
3. en unité pratique de quantité d'électricité :
   $e = 1{,}591.10^{-19}$ coulomb

Le proton est, comme l'electron, un point singulier de l'Ether, point autour duquel l'Ether se différencie :

1. en un champ électrique, identique au champ électrique de l'électron, mais de sens inverse.
2. en un champ magnétique variable,
3. en un champ gravifique, d'une nature toute différente des deux champs précédents, et constant, lorsque les conditions cinétiques restent constantes.

La masse ou inertie du proton, qui est environ 1847 fois celle de l'électron comporte :

1. une faible masse, de nature non gravifique, égale à celle de l'électron;
2. une forte masse, de nature gravifique, constituant, à elle seule, la presque totalité de la masse du proton. C'est, uniquement, à cette masse gravifique, qu'est dû le poids du proton.

On peut dire, qu'en comparaison de celle du proton, la masse de l'électron est presque négligeable.

Le proton ayant un mouvement de rotation et un mouvement de translation, et possédant une masse relativement considérable, peut présenter des caractères cinétiques importants.

L'électron et le proton, éléments constitutifs de l'atome, possèdant, dans celui-ci, une certaine énergie qnantique, minima, ou de base, qui correspond à l'état normal, ou de repos, de l'atome.

Cette énergie de base, de l'atome, peut être accrue, momentanément, par certains apports quantiques, d'énergie rayonnante, caractérisée par une fréquence propre.

L'énergide, ou quantam, de chacune des diverses sortes d'énergie rayonnante, a reçu, dans le domaine spectral de la lumière

posi... Ho... dealt ... Febr.

(infra-rouge, visible, ultra-violet) le nom de photon. Comme les diverses sortes d'énergie rayonnante, autres que l'énergie rayonnante lumineuse, ne diffèrent pas, fondamentalement, de cette dernière, le quantam d'énergie rayonnante peut recevoir, dans tous les cas, même dans celui des rayons de Roentgen, la dénomination de photon.

Le photon est, ainsi, une entité dont l' existence peut être éphémère et qui est émise par l'atome lequel préalablement excité, c'est-à-dire surchargé d'un quantum d' énergie supplémentaire, se débarrasse de cette surcharge, dès que la conservation de celle-ci ne lui est plus imposée par la nécessité de rester en un certain équilibre avec les conditions extérieures.

Cette entité n'a pas à intervenir dans le présent opuscle parce qu'il n'y est question *que de l'atome considéré à son état d'énergie* minima, de repos, de base, état dans lequel il est incapable d'émettre des photons.

Il est utile, cependant, de dire, ici, quelques mots du photon, à cause d'une certaine ressemblance que cette entité, dont l'existence peut être éphémère, présente avec l' électron.

Le photon est un point singulier de l' Ether est *différencié en un champ particulier*, de lignes de force tourbillonantes, limité par une surface fermée, et dont les dimensions varient rythmiquement. Le protou est, ainsi, une entité pulsatile.

Le caractère essentiel du photon est de se mouvoir, en ligne droite, avec une vitesse nécessaire et constante c, très voisine de 300,000 kilomètres par seconde.

L'énergie du photon est une énergie cinétique quantique qui est intégralement accaparée et utilisée en accroissement d'énergie cinétique par tout électron que le photon vient frapper. Avant d'avoir reçu un tel surcroît d'énergie, l'électron qui n'est pas enchaîné dans les atomes d'un corps est cependant emprisonné dans ce corps par l' obstacle alors infranchissable formé par la surface de ce corps.

Mais, dès qu'il a reçu le surcroît d'énergie cinétique que lui apporte le choc et l'évanouissement du photon, il est en mesure de quitter le corps dans lequel il se trouve, en franchissant la surface qui l'emprisonnait jusqu'alors. C'est l'explication classique de l'effet photo-électrique qui consiste en émission d'électrons par les corps lorsque ceux-ci sont frappés par des rafales de photons doués d'une hauteur de fréquence suffisante par exemple par des photons ultra-violets ou des photons de Roentgen.

Actuellement, les idées sur le photon, et sur l'électron considéré en mouvement, sont régies par la nouvelle théorie, dite *Mécanique ondulatoire*, de Louis de Broglie, théorie qui a, aussi, reçu de Schrœdinger, des développements importants.

Des expériences récentes ont mis hors de doute un fait, que la Mécanique ondulatoire laissant prévoir, consistant en ce que l'électron, et, probalement, tout projectile de masse suffisamment petite, n'obéit pas aux lois de la Mécanique classique, même modifiée en conformité de la Théorie de la relativité. La trajectoire d'un tel projectile épouse les rayons d'une onde dont la longuer d'onde est

$$\lambda = \frac{h\sqrt{1-\beta^2}}{m\,v}$$

formule dans laquelle
 h est la constante de Planck
 m a masse du mobile
 v sa vitesse, et
 β le rapport, de cette vitesse, à celle de la lumière.

La Mécanique ondulatoire, réussit à fusionner les deux points de vue, restés jusqu' ici inconciliables, des ondulations continues et de l'émission corpuculaire discontinue.

Nombre Atomique.

Le nombre atomique Z, présente, à la fois ce qui montre sa très grande importance, les significations dont voici l'énumération.

1. Il est une caractéristique numérique, *physique, importante*, prévue par Mendeleieff (1871), précisée et établie définitivement par Moseley (1918), et dont les valeurs coincident avec la série des nombres entiers, de 1 à 92.

2. Il constitue un numéro d'ordre, indiquant le rang occupé, dans la série naturelle des 92 nombres atomiques, par le compartiment (ou pléiade, ou élément chimique) auquel appartient l'atome considéré.

3. Il est égal au nombre des électrons qui constituent le système planétaire de l' atome neutre.

4. Il est égal au nombre total, des charges électriques élémentaires, négatives du systéme planétaire de l'atome neutre.

5. Il est égal au nombre, des charges électriques élémentaides, positives, résultants, du noyau de l'atome.

6. Avec l'hypothése, dont il va être question, il représente le nombre des constituants élémentaires unipositifs (e + 2 p) + qui composent le systéme intra-nucléaire de l'atome.

POIDS a DE L'ATOME.

La masse, ou inertie, ou résistance au changement de vitesse, se présente pour l'électron et pour le proton; mais elle n'est pas de même nature pour ces deux éléments primordiaux.

La masse de l'électron est relativement faible, et n'est pas de nature gravifique. Il en résulte que l'électron ne présente pas de poids.

La masse du proton, bien plus considérable, est au contraire de celle de l'électron, surtout de nature gravifique. Il en résulte que le proton présente un poids, et que ce poids, s'il est toujours évalué dans des conditions bien identiques, peut servir de mesure, pour la masse gravifique du proton et des groupements contenant des protons.

Si l'on prend, pour unité de poids, le poids d'un proton, le poids A, d'un atome est égal au nombre des protons qu'il contient.

Dans ces conditions, on peut admettre que la valeur que prend le poids A, pour un atome quelconque, est toujours un nombre entier.

Cela, toutefois, n'est pas rigoureusement exact, parce que, conformément aux vues d'Einstein, la masse de l'atome doit varier, un peu, avec la quontité d'énergie qu'il possède.

Mais, pour des atomes considérés à leur état d'énergie minima, ou état normal de repos, les différences, résultant de ce fait, sont très faibles, en sorte que l'on est en droit, dans les conditions ordinaires, d'admettre que le poids d'un atome est sensiblement égal, au nombre de protons qu'il contient.

Le poids, A, d,une espèce, donnée, d'atomes, ne doit pas être confondu avec le poids atomique A' (ou A_c) de la Chimie. Celui-ci, est, le poids moyen, d'un certain nombre d'atomes, de poids différents, appartenant à une même pléiade. On peut dire, par conséquent, que le poids atomique de la Chimie, est, en général, non pas le poids d'un atome réel, mais le poids d'un atome fictif, et que ce poids doit être, le plus souvent, fractionnaire.

COMPOSITION GLOBALE DE L'ATOME

Ici, nous ne considèrerons l'atome, qu'à son état normal neutre.

Son poids étant A, l'atome contient A protons.

Étant neutre, il contient, nécessairement A électrons.

[illegible]position globale, en électrons et [illegible] atome neutre, est donc, néces-

[illegible]

Comme, dans l'Univers, une très forte proportion des électrons et des protons sont engagés dans la constitution des atomes, cette égalité, plaide en faveur de cette idée, que le nombre des électrons et celui des protons sont, peut-être, égaux et qu'ils ont, peut-être, une origine connexe.

Nous allons examiner comment on peut se représenter la répartition, dans l'atome, des A électrons et des A protons qui le constituent, à l'état neutre.

Il y a 92 éléments chimiques, ou 92 pléiades d'atomes, connus ou prévus; mais il y a, au moins, 190 espèces d'atomes, parce que chacun des compartiments de la Classification (pléiade ou élément chemique), comprend, en général, plusieurs espèces d'atomes, qui diffèrent, entre elles, par leur poids.

Les diverses espèces d'atomes, ou isotopes appartenant à une même pléiade (ou même élément chimique), présentent, à l'état neutre, les caractères connexes, suivants. Elles ont :

1. le même nombre atomique Z;
2. le même nombre Z d'électrons planétaires et, par conséquent, la même charge électrique, négative, planétaire, Z;
3. la même charge positive, nucléaire, Z;
4. les mêmes propriétes chimiques (ce qui empêche de les séparer, les unes des autres, par les méthodes usuelles de la Chimie).

Mais, les diverses espèces d'atomes, d'une même pléiade, diffèrent, entre elles, (sauf dans le cas d'isotopes isobares) par leur poids, c'est-à-dire par le nombre de leurs protons.

Or, les protons sont confinés dans le noyau de l'atome, noyau qui est composé d'un ensemble, de protons et d'électrons, tel, que l'excédent du nombre des protons, sur le nombre des électrons nucléaires, est nécessairement égal au nombre Z des électrons planétaires. Le nombre des protons, tous nucléaires, étant A et le nombre des électrons nucléaires est A-Z.

Puisque deux isotopes, c'est-à-dire atomes appartenant à une même pléiade, diffèrent par leur poids, c'est que le noyau, de l'un, contient plus de protons, que le noyau de l'autre. Mais, d'autre part, la charge électrique, positive, du noyau reste nécessaire la même, pour les deux isotopes considérés, puisqu'elle doit rester égale à la charge électrique Z du système planétaire.

Donc, les noyaux de deux sortes d'atomes d'une même pléiade, différant par un certain nombre i de protons, diffèrent néces-

sairement, aussi, par ce même nombre i d'électrons nucléaires.

Autrement dit, deux sortes d'atomes, de poids différents, appartenant à une même pléiade, diffèrent, *nécessairement*, entre eux, par

$$iE+iP$$

électrons et protons qui doivent, vraisemblablement, constituer i groupements neutres $(E+P)$.

Nous allons examiner

1. la place probablement occupée, dans l'atome, par ces i groupements neutres $(E+P)$,
2. la valeur du nombre i, en fonction de Z et de A.

DIVISION DE L'ATOME EN 3 SYSTEMES

Dans les conditions que nous venons de définir, il y a lieu de distinguer, dans l'atome, trois systèmes concentriques, formant deux régions, à savoir :

I. Une région externe, qui constitue :
 1. le système planétaire, négatif (charge $-Z$)

II. Une région interne, ou noyau, se divisant en deux systèmes :
 2. le système péri-nucléaire, neutre, et
 3. le système intra-nucléaire, positif (charge $+Z$)

Un tel atome peut être caractérisé, provisoirement, par 3 nombres qui sont :

Z, le nombre atomique,

A, le *poids de l'atome*, ou *nombre* des protons du noyau (systèmes péri-nucléaire et intra-nucléaire réunis),

i, le poids du système péri-nucléaire, ou nombre des groupements neutres $(E+P)$ qui constituent ce système.

Avec ces 3 nombres on a pour un atome quelconque la composition suivante :

1. système planétaire négatif $Z\ (E)$
2. système péri-nucléaire, neutre $i\ (E+P)$
3. système intra-nucléaire, positif $(A-i-Z)\ (E)+(A-i)P$

compositions donc le total est, nécessairement, $A\ (E+P)$

RAPPORT DU NOMBRE ATOMIQUE, AU POIDS ATOMIQUE, CHIMIQUE.

On a remarqué, depuis longtemps, que le *poids atomique*, A_c d'un élément chimique, est égal, ou à peu près égal, au double le son *nombde atomique* Z.

En fait, ce rapport

$$\frac{A_c}{Z}$$

varie de 2.00 à 2.21, dans la première tétrade de périodes (1H2 à 20 Ca),

de 2.14 à 2.58, dans la deuxième (21 Sc à 92U).

RAPPORT DU NOMBRE ATOMIQUE Z AU POIDS $A-i$ DU SYSTEME NUCLEAIRE.

Nous avons été amené à nous demander si, en la modifiant, la règle approximative, dont il vient d'être question, ne pourrait *pas devenir une règle rigoureuse*.

Or, pour qu'il en soit ainsi, il suffit d'appliquer la règle non pas au poids de l'atome, *généralement fictif, qui représente* l'élément chimique (mélange d'atomes de poids différents), mais au poids du système *intra-nucléaire de chacun des atomes réels*.

Autrement dit, la règle est : Le poids $A-i$ (nombre de protons) de l'intra-nucléus, d'un atome quelconque, est *le double de son* nombre atomique Z.

De cela résulte que le nombre atomique et le poids de l'intra-nucléus restene nécessairement, l'un et l'autre constants, dans la pléiade.

On a ainsi, pour toute espèce d'atomes, sans exception, c'est-à-dire pour les 190 espèces connues :

$$A-i=2Z$$

ce qui donne :

$$i=A-2Z$$

(*a Suivre*)

THE CANADIAN MAGNESITE INDUSTRY.

THE STORY OF AN INDUSTRY REJUVENATED BY RESEARCH.

STRIKING RECENT EXPANSION OF BUSINESS.

One of the Canadian industries particularly hard hit by the economic adjustments following the close of the war was that concerned with the manufacture of magnesian refractories, which had been carried on in the Grenville district of the Province of Quebec.

The supplies of magnesite utilised by the steel industries of the allied countries had before the war been obtained from Austria, but on the outbreak of war rapid development was necessary of alternative supplies in Greece, California, Washington and Quebec.

The Quebec deposits, situated about half way between Montreal and Ottawa, a few miles north of the Ottawa River, are dolomitic in character, and the lime introduced in the dolomite caused most steel men to look upon the product with disfavour. However, the demand for magnesite was such that the industry expanded rapidly, the value of the annual exports of dolimitic magnesite rising to over a million dollars. When the war was over, Austrian magnesite again became available at a low price and

for some years the Canadian producers encountered difficulty in marketing their product in spite of the adoption of improved business methods. The principal companies arranged for co-operative workings of their quarries and kilns and instituted an energetic sales campaign. By 1925, however, it had become evident that these measures alone could not effectively meet the situation, and the companies appealed to the Dominion Government for assistance. The Government gave them a sympathetic hearing, and requested Dr. Tory, the President of the National Research Council, to investigate the companies' technical problem and to render them any possible assistance.

The National Research Council appointed an Associate Committee on Magnesite under whose direction a series of researches have been carried out at the metallurgical and ceramic laboratories of the Dominion Department of Mines.

The chief objective of the steel industries to Canadian dolomitic magnesite is in relation to its lime content, and efforts have been made by two distinct methods to overcome the difficulty. One method was to reduce the lime content and the other to render it inert.

A method of reducing the lime content, as well as that of the associated silica, was doubly desirable. First, it would enable the companies to utilise a much larger proportion of the quarried rock, the greater part of which it was found necessary to discard, owing to its high percentage of contained impurities. Second, a product lower in lime and silica would meet with more favour amongst the steel men, and would make possible the sale of a purer refractory in competition with Austrian magnesite.

The method to accomplish this end consists in a carefully controlled calcination of the crushed rock, so as to decompose its magnesite constituent and make it soft and friable, at the same time leaving the impurities comparatively hard and strong. A light crushing operation pulverised the soft calcined magnesite, and the coarse impurities are then removed by screening. The method was first worked out in the laboratory, and the staff then demonstrated the process in the companies' plant, proving it to be cheap and effective in commercial operation. A patent has been obtained on this process.

It is evident, however, that the second [illegible]ethod of solving the problem, if feasible, [illegible] be preferred, since it permits the ful[illegible]sation of the rock, and results in a larger tonnage of product from the same quantity of raw materials. A long series of laboratory experiments was undertaken, and it was fully demonstrated that the composition of the kiln feed could be so regulated as to even permit an increase in the quantity of lime present. The character of the product, moreover, makes possible a decided improvement in the metallurgical application of refractories.

To understand the force of this last statement one must consider the method of using Austrian or other "pure" magnesite clinker in forming the hearths of open-hearth steel furnaces. Such magnesites do not soften at ordinary working temperatures sufficiently to "set" to a firm mass, and it is consequently the practice to mix with the magnesite a quantity of fusible slag, which softens and binds the refractory particles more or less firmly together. Such a hearth, however, requires a very long period to burn in, and is at best a heterogeneous mixture. The dolomitic Canadian magnesite, however, though highly refractory, possesses the property of "setting" at temperatures readily attainable. It is quickly burned in, thereby greatly reducing the cost of this expensive operation, and forms a monolithic bottom which gives long and highly satisfactory service. The best indication of the favour with which this improved product is being received by the steel makers is the fact that it is selling freely in the United States at a price considerably above that of competing refractories. The market previously lost has thus been more than regained.

Recent demand for this material in Canada, the United States and England has been such that the producers have been able to meet it only by a considerable increase in the capacity of the plant. Both Canadian and foreign patents have been applied for on this product.

The success of the experiments in controlled calcination was such as to indicate a possible new use for calcined dolomitic magnesite. Fairly pure calcined magnesite, or "plastic magnesia" has long been used on a small scale mixed with magnesium chloride solution to form a rapid-setting and strong oxychloride cement, suitable for stucco, composition flooring and other purposes. Such material has not been uniformly satisfactory, however, due to the fact that even the purest of it contains some free or active lime, and to its slaking on being stored. Since experiments had proved it possible to calcine dolomitic magnesite without the production of appreciable active

lime, it was evident that such a calcine could be used as plastic magnesia. Further, experiments demonstrated that the small amount of active lime in it could be effectively neutralised at the time of pulverising, and that the product could be kept in special containers without appreciable slaking, thus overcoming two of the chief difficulties encountered in the use of foreign plastic magnesia.

Commercial application has now been made of the method devised to produce plastic magnesia, and an improved product has recently been placed on the market. This product is used in the composition floors now being laid in the laboratories of the National Research Council.

At the request of the Forest Products Laboratory the Council's staff undertook to develop a method of making in towers magnesium bisulphite liquor for use in the manufacture of wood sulphite pulp. If ordinary raw magnesite be used for this purpose, it is found to dissolve too slowly, and to produce a slndge which tends to choke the towers. When calcined it is very readily dissolved but possesses insufficient mechanical strength. It has been found, however, that when finely ground or slaked it may be fed with water into towers already filled with coarse limestone, or other suitable material, when it will go readily into solution, producing bisulphite liquor whose composition can be varied over a wide range, as desired. A Canadian patent has been secured npon this method of application.

An investigation of the possibility of mannfacturing refractory brick from Canadian dolomitic magnesite has been under way for some time. A great number of difficulties were encountered, but most of these have been overcome. The brick produced have proved in actual furnace use to possess certain desirable properties to a very unusual degree, and it is hoped that this work may soon be pushed to a successful conclusion.

The magnesite researches are being continued in the laboratories of the National Research Council at Ottawa with support from the operating companies.

CANADA'S COKE PRODUCTION.

Coke is being produced in Canada chiefly by the treatment of bituminous coal; a small production is also obtained from the distillation of petroleum. Coke derived from the treatment of coal or petroleum is now produced in almost every province of the Dominion.

THE ITALIAN RUBBER INDUSTRY.

The rubber industry is of relatively recent origin. It started in Italy practically at the same time as in other countries, a little more than 50 years ago : in 1872 the first rubber goods factory was opened in Milan.

For over 20 years this factory was the only establishment to represent in Italy this branch of industry, to which, a few years after its inception, the production of isolated electric conductors was added.

During the last thirty years a number of other factories of rubber articles have been established, almost all in Lombardy and Piedmont, and more particularly in the two principal centres of these regions, Milan and Turin.

Italy has at the present time 54 works between big and small ones, devoted to the production of rubber goods and isolating electrical conductors; 3 of these turn out both forms of production, 33 confine themselves to the manufacture of rubber goods, and 18 to that of electrical conductors.

Raw Material.—The consumption of raw materials used in the several branches of rubber manufacture has of recent years attained to an aggregate of some 70-75 thonsand tons for rubber articles and some 40 thousand tons for electrical conductors, distributed approximately as follows :

RUBBER MANUFACTURES.

	Tons
Raw Rubber	10-11,000
Diverse chemical ingredients (Carbonates, sulphur, oxides, etc.)	13-14,000
Cotton fabrics & yarn ...	2,500-3,000
Iron bars and wire	3,500-4,000
Petrol	1,800-2,000
Fuel	40-41,000

CONDUCTORS.

	Tons
Copper and Lead	20,000
Other materials (Iron tape & wire, textile materials, rubber, paper for cables, mineral oils, etc.)	20,000

The value of the said raw materials is in the vicinity of 400 million lire for the rubber articles and 200 millions for the isolating electrical conductors, thus giving a total of about 600 million lire.

The industry depends on foreign supplies for a good part of the raw material it consumes (rubber, petrol, fuel, copper, etc.). A single concern that owns three of the most important factories has rubber plantations of its own in the Far East. The great progress made by the Italian rubber industry is

all the more striking on this account, especially when it is considered in relation to the necessities and difficulties depending on foreign supply. Indeed, the importation of raw rubber, which before the war averaged about 3 thousand tons per annum, rose in 1928 to nearly 13,000 tons, and has increased steadily during the last ten years.

Production.—As regards variety of production, the Italian rubber industry comprises all articles and manufactured goods, for technical and industrial uses, and isolating electrical conductors of all types; the manufacture of submarine telegraphic and telephonic cables having been added in 1887. The manufacture of rubber galoshes form the only exception; this branch has not yet been taken up.

As a whole, Italian production can be estimated, in terms of the average prices for 1928, at 600 million lire for rubber articles and at 300 million lire for electrical conductors, giving a total of 900 million lire.

The principal types of electrical conductors manufactured in Italy are the following:

Isolated electrical wires and cords;

Metal-covered cord and cable for power transport;

Submarine telegraphic and telephonic cable.

The following are some of the principal products:

Wire for insulating wrappings; bell wire; flexible electric light cords; air-line wire and cord; armoured cable for power transmission; air, submarine, and underground telephonic and telegraphic cables and accessories; conductors for shipping equipment; conductors for mobile motors and agricultural machines; conductors for automobiles; conductors and cables for mines; elevator cables; flexible cords for dynamos; diverse conductors for radio-telephony; wire and cable protected against fire; flex for radiators, ventilators, electric irons, etc.; conductors for portable apparatus; field telephone and telegraph cords; cords for telephone and signalling apparatus; cords for telephonic intercommunication; conductors for "Neon" and other forms of *gas lighting plants, etc.*

Rubber articles.—The following are the most important articles produced:

Pneumatic tyres (outer covers and inner tubes) for automobile, bicycle, aeroplane, [illegible]nd other vehicle wheels;

pos[illegible]id tyres for autocar wheels and rub-dealt w[illegible]s for carriage wheels;

Articles for technical uses (belts, tubes, etc.);

Rubber articles for medical and surgical purposes;

Sports articles and rubber toys;

Rubber and waterproof fabrics;

Elastic thread, etc.

The first place, in order of importance, is occupied by rubber pneumatic tyres (outer covers and inner tubes) and solid rubber tyres for vehicle wheels. The most important products are: covers and inner pneumatic tubes of all kinds for automobiles; solid tyres for heavy auto-vehicles, tractors, and trade-vans; semi-pneumatic hoops for autocars, motor-'buses, tractors, towing cars, etc., light semi-pneumatic wheels for motor vehicles; covers and inner tnbes for motor cycles, sidecars, cycles with motors, small lorries, etc., covers and inner air tubes for bicycles; hoops for army cycles, carriage wheels, perambulators, wheel chairs, afbulances, etc.

Among articles for technical nses the principal items manufactured are: transmission belts; tapes for conveyors and elevators; tubes for wine making; hydraulic, steam, air, and other tubes; packing for rollers, cylinders, machines, and parts of machinery for industries of all kinds; sheets and plates for valve making; rings of all kinds; gloves and fingers for chemical industries and all other industrial uses; articles for spraying pumps, for hat factories dye-works, mines and railways; shipping.

GENERAL NOTES.

UNIQUE COAL RAILWAY.

HANDLING 3,000 TONS OF GOODS A DAY.

S.M.G.C.R. EXPRESSES.

Two new locomotives, each capable of drawing a load of nearly a hundred tons, and driven by petrol distilled in the process of the manufacture of gas, have just been put into commission at East Greenwich on London's longest private railway.

Hundreds of thousands of tons of coal from the Northumberland and Durham mines are brought during the winter months to the Thames-side stations of this model railway (which is the property of the South Metropolitan Gas Company) to provide light and heat for more than 400,000 South London homes. Although very few gas consumers realise the comprehensive nature of this railway, the S.M.G.C.R. has been in existence for more than forty years.

There are now twenty-two locomotives in service, and a regular time-table is adhered to. Express trains deal with the discharge of coal, and the loading of coke at the docks for export to the Continent. At the jetties the railway is elevated forty feet, to expedite the handling of goods to and from the steamers.

There are more than twenty miles of railway track connecting the various depots of the South Metropolitan Gas Company and at East Greenwich is also situated one of the largest gas-holders in the world.

Over a hundred men are employed on work in connection with the railroad, including engine-drivers, stokers, signalmen, guards, checkers, donkeymen, etc. There are five main signal boxes, and, owing to the large number of branch lines, an intricate system of signals is maintained.

Some idea of the activities of the railway may be gathered from the fact that during this month approximately three thousand tons of coal are being unloaded every day from steamers at the jetty and, in addition to coal and coke, iron and steel goods and oil and petrol are also transported. No passengers, however, are allowed to travel on the railway.

Many of the wagons and trucks in use are made in the company's own workshops, where they are also repaired and overhauled. They are made to a special design and, to facilitate rapid unloading, are discharged by the touching of a small lever.

PATENTS COMMITTEEE, 1929.

BOARD OF TRADE ANNOUNCEMENT.

The Committee, which was set up under the chairmanship of the Right Hon. Sir Charles Sargant to consider whether any amendments in the Patents and Designs Acts, or any changes in Patent Office practice, are desirable, are continuing their weekly meetings at the Board of Trade for the purpose of hearing evidence from interested persons and associations. Twenty meetings of the Committee have taken place and during the next few weeks evidence will be taken from representatives of the Chartered Institute of Patent Agents, the Law Society and several Chambers of Commerce.

Any persons or associations who desire to submit any further suggestions, or to give evidence, should notify their intention to the Secretary to the Committee, Mr. R. W. Luce, Industrial Property Department, Board of Trade, 25, Southampton Buildings W.C.2., not later than May 1st next.

THE CHEMIST AND COMMERCE.

The Institute of Chemistry's First S. M. Gluckstein Memorial Lecture, December 13, 1929.

By LESLIE H. LAMPITT, D.Sc., F.I.C.

It is about two years since the late Mr. S. M. Gluckstein lectured to the London and S.E. Counties Section of the Institute of Chemistry on "The Chemist and Dividends," and I accepted the honour offered me by the Council of the Institute to be the first S. M. Gluckstein Memorial lecturer because I had been associated with Mr. Gluckstein during the introdnction into the firm, of which he was a director, of the idea and ideals of a laboratory. Moreover, it seemeed to me that, inspired by his words, it should be possible to give a paper complementary to his address.

I felt that, as a chemist speaking to chemists, I could show some of the ways in which we have tried to work out the ideas which Mr. Gluckstein held on this subject. He was a man of far vision, not content with the best of to-day, a man with imagination and, as such, combined with his commercial knowledge, he was wonderfully fitted to take to himself and to nurture the introduction of chemical science into a very flourishing business. It will be understood that it is one thing to start a business in conjunction with scientific thought, and an entirely different thing to introduce science into a business organisation, which has achieved far, far above the average of commercial success.

By "The Chemist and Commerce," I mean the position of the chemist in the commercial world of to-day and to-morrow —I say "to-morrow," because "to-day is going, and we must prepare for the morrow. And "to-morrow," it is my firm conviction, will see the position very different from what it was yesterday. "To-day" is a time of revolution, a time, perhaps rather, of evolution; a fact plain to be seen by those chemists and commercialists whose eyes are open. We have had the steam revolution, the electrical revolution, and now—the chemical revolution, the change over from rule of thumb to scientific control. This involves a more liberal and more extended interpretation of the word "Chemist" than is usually given to it, but you will notice that later on I speak in more detail of the attributes which I regard as necessities in the chemist who decides to became a spoke in the wheel of industry.

The commercial well-being of a nation will depend upon its chemists, and whereas Capital and Labour strive for supremacy (for neither appears to want true collaboration), it will be the chemist, and in this I include the other technical scientists, who will *control the destinies of both.* This is as sure as that day follows night. Consequently, the chemist must fit himself to think commercially when the necessity arises; but, on the other hand, a mind too commercial builds barriers around possibilities which any true chemist can see in his imagination; for if, before conducting a research or an investigation, the chemist sits down to try to work out what it will cost, the result may be fatal to advancement. Imagination is essential to progress, and as it is essential that the chemist should be always in the forefront of the advance, he must from time to time give free rein to his thoughts, look far into the future, build up step by step an investigation, and finally lose himself in the multitude of possibilities which he foresees. No chemist is worth his salt unless he can so lose himself, but he must also be able to come back to earth and concentrate on the immediate needs of the investigations in hand, and be prepared to meet his employers with a cut-and-dried scheme.

But because of the absolute necessity to ensure that the imagination and vision of himself and his assistants shall not be stultified, he must induce his employers to allow him to carry out certain work which may *not promise* any commercial gain in the immediate future. A chemist without imagination in industry is a drag on industry. He becomes an automaton, a mere cog in a machine; a cog, which I am sorry to say, very often does not mesh properly with the other cogs. Routine chemistry in industry has its place; it is most essential, but routine work can never be expected to raise the chemist on to what our American friends call " the executive bodies of industry."

As I see it, industry will be conducted more by collaboration than by the mere employment of one set of people by another. The former are employers, not because they have any better brain than those whom they employ, but because *they have capital*, or the means of getting it, and have, above all things, personality and the power of exploiting the industry of others; but I do not mean by exploiting, anything that is immoral, where morality is taken as the standard by which one man treats another.

deal

The commercial man has his sphere; the chemist has his, and industry will go forward by means of a true collaboration between the two. Unfortunately, chemists have become used to the idea that they are not commercial; in fact, the word " *commerce* " *is, to many so-called academic* people, a term of opprobrium. Now, as soon as you admit a deficiency to yourself or let your inferiority complex come into play, other people will judge you by your own standard, and the attitude of the commercial heads of industry to-day, although changing, is still that the chemist is a type of idealist, with his head in the clouds, who is interested in nothing but the best and most expensive. This leads me to deal with the attitude of the chemist towards production. His objective is to produce the best articles at the cheapest price, irrespective of their selling price. He must, therefore, be prepared to be unpopular and to take up a firm attitude with those who are desirous only of cheapening the quality of the article, because if the chemist has the confidence of his firm, his opinion on quality will be regarded as a sound judgment. It is for this reason again that he must not fall into the habit of thinking too much on commercial lines, otherwise his opinion may itself become biassed.

To this country in particular chemists are of utmost importance, if we are to maintain, not our commercial supremacy which is almost a thing of the past, but a sufficiency of industry to keep our people in employment. The criticism of our industrial organisation and our factory equipment is, to my mind, fallacious. Unfortunately, the cry, often used on political platforms, is " Improve your organisation, modernise your equipment, and your trade will flourish."

As one who has been fortunate enough to travel over the greater portion of North America, and over practically the whole of Europe, I can definitely say that I do not consider industry in its organisation and equipment in England to be one whit behind the industry of other countries. I have seen milk products made in as unsatisfactory dairies in the United States or in Holland as the poorest in this country, and I have seen milk factories here which compare with the best in those two countries. Our heavy chemical works are as modern as those of Germany, and our big food concerns are not out-shone by any I have seen in any part of the world. In other words, it is not on the purely technical plane that we can

improve in order to better our trade, but, if I see aright, it is by employing in industry those who have the power to develop new processes and to standardise others (for by this means the cost of production is lessened) that we must look for any trade advantages to be gained. Our old markets are going : Dominions, Colonies and Protectorates are developing their own industries, will continue to do so, will make things for themselves, and, therefore, unless we can produce things cheaper or better, we cannot hope to keep our huge industrial population alive. The solution of the problem lies chiefly in the hands of the chemist.

Commercial processes may appear depressing, and that small germ of desire for truth, probably instilled in the mind of the youthful student, is so often killed, with the result that the process chemist soon develops into the super technician ; "super" merely in comparison with the foreman, who has probably run the process satisfactorily previous to the advent of the chemist, and even then only " super " because he has methods of checking—in other words, tools, which his predecessor did not possess. Herein is a real danger, and one which must be guarded against. It is often so much more easy to run a series of tests on the " hit and miss " system, than to get down to the principles which underlie the process, and then to calculate or deduce the solution of the problem. It is one thing to talk in technical phrases, another one to think in scientific terms of the same process; yet when the former is the habit, the spirit of chemistry soon dies leaving the body the simulacrum of the scientist, but of little more use as a potential factor in the development of industry than is the untrained workman, who in a routine-like fashion carries out his day's work.

(*To be continued.*)

THE VOLUME OF SAVINGS HAS FALLEN.

It is generally agreed among those who have studied the problem, says F.I.B. Circular, that the total real savings of the country have fallen substantially below the pre war level. While it may be true that certain established corporate undertakings have been able to maintain their savings by means of undistributed profits, it must be remembered that the exigences of the post war period have called for greater savings rather than the *same* savings as before the war. This has been partly to enable schemes of reorganisation to be undertaken, partly to permit the laying down of fresh plant and partly to enable experiments to be made in new lines and developments; in short to enable the change over from pre war to post war conditions to be made and to assist British trade to resume its position in the van of industrial progress.

It is unnecessary to point to the moral in regard to the effect of any further increase in taxation, especially as the Federation has already made its views clear on this point, on similar occasions in the past, (notably in connection with the effect of Taxation upon the Reserves of Limited Companies.)

THE DOUBTFUL OUTLOOK FOR THE FUTURE.

The results of British trading during 1929 are sufficiently well known to make it unnecessary to do much more than observe that there is nothing in the evidence at present available to warrant the view that it was appreciably better than in 1928. Such slight improvement as was experienced was in the main in the heavy basic industries which must progress considerably above their present level before they can be regarded as profitable assets from the revenue point of view. Our export trade figures (exclusive of coal) can only be made to recohd an improvement by making special allowances for the fall in raw material prices which occurred largely as a result of the disorganisation of finance and commerce by the circumstances attending the New York Stock Exchange boom and the crisis which brought it to a culmination—events which also are not promising from the point of view of tax collectors.

Proceedings and Notices of Societies

THE PHYSICAL SOCIETY.

January 24.

A method of examining Stereoscopic Photographs." By J. M. NUTTALL and E. J. WILLIAMS.

The paper describes a method of analysing stereoscopic photographs which has been found suitable for the examination of Wilson cloud tracks. The method consists essentially in replacing the photographic plates in the cameras, illuminating them and tracing out the common image which coincides in space with the object originally photographed. A system of movable pin points is used to trace out the contour of the image, the adjustments of the cameras being kept exactly the same as when the photographs were taken. The chief advan-

tage of the method is its simplicity : practically no computation is required and it is not necessary to know the stereoscopic angle the magnification, etc. The method has been used by the authors to measure the ranges of secondary β rays and in investigations of the initial directions of emission of photoelectrons, and it has been found convenient and accurate.

Imperfections in the lenses are no more detrimental to our method of *examining* the photographs than they are to the *production* of accurate photographs, and the error arising from this source is of the same order of magnitude whichever method is employed for the examination of the photographs. In fixing a pin the observer uses the central rays through the lenses by adjusting the position of his eye so that the image is in the middle of the field of view. Errors introduced by the use of rays through the periphery of the lenses depend on the ratio of their apertures to their distance apart in the stereoscopic camera. As the diffuseness of the photographic images of point objects is due to the rays coming from different parts of the lenses an error of the same magnitude will be incurred if, in determining the original position in space of the points photographed, measurements are not made on the centres of their diffused images on the plates. The extent to which the conditions for accurate measurement by the present method can be adhered to is shown by the very satisfactory results quoted and referred to in the paper. The method used is in certain respects the same in principle as those used in air survey and it may be regarded as an extension or perhaps a simplification of such methods. In the present method a full-scale reproduction of the shape of the original object is made, and no optical apparatus in addition to the camera itself is used.

"*The Photography of Fabry and Perot Interferometer Fringes by the use of a Simple Optical System.*" By S. E. GREEN, B.Sc., Imperial College of Science.

A simple method of photographing Fabry and Perot interferometer fringes is outlined, and some examples of the results obtained for mercury radiation are given.

The mercury lamp used was a Cooper-Hewitt lamp, having a glass tube 2cm. in diameter and carrying a current of 3.3 amp. It was inadvisable to obtain a brighter source of light by overrunning the lamp, in view of the broadening of the spectral lines consequent upon the increase of temperature and pressure. The preliminary set of photographs taken in earlier experiments and shown at the meeting have enlargement factors from the original negatives varying between 1.8 and 2.5.

With regard to the effect of the conditions in the source on the interference pattern produced, perhaps I may mention that on attempting to analyse the mercury radiation from a vertical capillary arc operating at a pressure of about 90 cm. of mercury and carrying 0.3 amp. I found that the fringe system in a Fabry and Perot étalon had vanished almost completely, whereas the Cooper-Hewitt lamp gave satisfactory fringes. Ths was apparently due to the excessive widening of the spectral lines at the high temperature and pressure of the capillary arc. It is possible that the fringes given by the Cooper-Hewitt lamp might have been further sharpened by reduction of the current strength below 3.3 amp., but any advantage gained would have been largely offset by the necessity for longer exposures.

"*Characteristics of Discharge Tubes under 'Flashing' conditions, as Determined by the use of a Cathode Ray Oscillograph,*" By Miss W. A. LE-SHON, Ph.D.

An account is given of a method of determining the current voltage characteristics of discharge tubes under "flashing" conditions, a cathode ray oscillograph being used. Results are given for neon lamps of the commercial Osglim type. Current/time and voltage/time curves are derived from the oscillograph records.

The method might prove useful in investigations of intermittent discharges in various gases undel different conditions of pressure and disposition of the electrodes.

GEOLOGICAL SOCIETY OF LONDON.

February 5, 1930.

The following communications were read :

"*The Tuedian Beds of Northern Cumberland and Roxburghshire east of the Liddelwater.*" By Prof. EDMUND JOHNSTON GARWOOD, M.A., Sc.D., F.R.S., V.P.G.S.

The series consist of sandstones, mudstones, shales, and impure limestones laid down mainly under lagoon conditions. An interesting feature is the important algal development in the middle of the series.

The beds are intermediate in character between the freshwater facies of the Tweed district and the more marine facies of Westmorland. The succession is described under three districts :—

Northern Cumberland (Bewcastle district)

Roxburghshire (Newcastleton district)
Western Northumberland (Rothbury)

In Northern Cumberland thet structure is that of a denuded anticline having a general north-north-easterly trend. The district is also traversed by several important faults which preserve the same general direction.

This area may be divided into two districts separated by the " central " fault.

The Bewcastle district in the east is taken as the type, and the following succession has been determined here :—

C—S Kingwater Beds.
Fell Sandstone.
C_2 Cam Beck Beds.
Chronetes aff. *hardrensis* Band.
Syringothyris-Derbya Band.
Upper *Productus-teres* Band.
C_1
Main Algal Series.
Bewcastle Beds.
Z_2—C_1 Lynetbank Beds.
Lower *Productus* Band.
Myalina Beds.
Pustula-interrupta Beds.

The base of the Carboniferous is not exposed, but the oldest beds containing *Pustula interrupta* and *Athyris concentrica* appetar to belong to Z_2.

The algal episode enters first in the Bewcastle Beds; but the conditions were unfavourable, and it is not until the Main Algal Series is reached that algal growths become later algal development occurs near the summit of the Cam Beck Beds, which is characterised by the association of *Spirorbis caperatus*.

On the whole, the fauna becomes more marine as the beds are traced from north to south, and near Sq adeadam the highest beds of the Cementstone series contain *Michelinia grandis* associated with an impoverished Arnside fauna testifying to their C_2 age. The beds at the summit of the Fell Sandstone in the Kingwater area contain a rich fauna, which may be compared with a similar assemblage that characterises the S_1 beds on Ashfell Edge, overlying the Ashfell Sandstone. A further exposure of these beds occurs at Clattering Ford in the Black Lyne, but the overlying beds are difficult to correlate in the two districts.

In Roxburghshire east of the Liddelwater, the algal series is again well developed, but the Upper *Productus* Band is absent. An interesting occurrence, however, of the *Syringothyris* Band is found associated with *Palœacis* and a single specimen of *Vaughania*. In Northumberland, the chief feature of interest is the rich development of *Mitcheldeania* and *Ortonella* near the summit of the Cementstone Group, the latter genus being especially characteristic of the two highest limestones in the neighbourhood of Rothbury.

"*Pre-Ordvician Rocks of the McDonnell Ranges (Central Australia).*" By Sir Douglas Mawson, O.B.E., B.E., D.Sc., F.R.S., F.G.S., and Cecil Thomas Madigan M.A., B.E., F.G.S., (Read by Dr. C. E. Tilley, B.Sc., F.G.S.)

This paper concerns the age and stratigraphical relations of a great series of a great series of quartzites, slates and limestones forming the southern front of the McDonnell Ranges. These beds, dipping at a steep angle off the older Pret-Cambrian basement (Arunta Complex) of the Ranges, extend in an east-and-west direction with wonderful regularity for a length of at least 150 miles. The three principal quartzite members of the group weathe rout in great wall-like masses, separated by intervening valleys carved out of the calcareous and shaly sediments, and their outcrops south of Alice Springs have been correlated with the well-known fossiliferous Ordovician rocks of the Horn Valley at the Finke River Gorge.

The Anthors now provide evidence to show that this great series of rocks lie stratigraphically between the undoubted Ordovician rocks (Larapintine formation) and the Arunta Pre-Cambrian Complex.

The stratigraphical succession is as follows :—

(3) Pacoota Quartztite (Larapintine.
(2*b*) Pataoorrta Series—quartzite, shales limestones (2,850 feet).
(2*a*) Pataknurra Series — quartzites, slate, limestones (7,500 feet).
(1) Aruntea Complex (Pre-Cambrian).

They form a Pre-Ordovician series, upon which rests unconformably the Larapintine Formation with its basal members formed of conglomerates and breccias. Horizons rich in Cryptozoa and *Girvanella*-like algal growths characterize the series. The Cryptozoa of the lower series are identical with those occurring in beds associated with the Sturtian tillite in the Flinders Ranges of South Australia, and the rocks are tentatively referred to the late Pre-Cambrian. The Upper Pataoorrta Series, referred to the Cambrian, is characterised by dendritic varieties of Cryptozoa and *Girvanella*-like algal growths which closely resemble those occurring in the Cambrian rocks of Southern Australia.

THE STORY OF SUGAR.

The appearance of *A Handbook for Cane-Sugar Manufacturers and their Chemists*, by the late Dr. Guilford L. Spencer (seventh edition, revised and enlarged by George P. Meade, B.S., CH.E., pp. xx + 560. New York : John Wiley & Sons; London : Chapman & Hall. 1929. Price 30s.) is particularly opportune at a time when much attention is being focussed on the critical period through which the sugar industry is passing.

The extraction of sugar from plant juices goes back to antiquity although the earliest evidence of the solid substance being used is from Persia about A.D. 500. It was manufactured in Egypt during the 9th and 10th centuries and was gradually carried to Java and the Phillipines and later to Cuba and America.

Beet sugar dates from the 18th century and has since competed severely with the cane sugar production. The total production has increased so rapidly of recent years that there is now an "over-production." The output has trebled during the present century and measures are now being taken to prevent further over-expansion and fall in prices. Legislation has been passed in many countries to protect home grown and home refined products.

The production of sugar in the past year was again in excess of the world's requirements; in fact the estimates for the 1928-29 season indicated a larger output than in any previous season. Over-production has continued in a more or less acute form ever since the War period, and it is surprising that the decline in prices to what is asserted to be an unprofitable level has not had any restrictive effect on the output by eliminating the weaker producers. To some extent this is explained by the fact that in a number of countries the production of sugar is encouraged by State assistance, and on this subject the League of Nations Committee of experts appointed last year to investigate the conditions of the sugar industry reported that the measures taken by various Governments to stimulate sugar production artificially had aggravated the crisis in the industry. The experts expressed the opiniou that the difficulties of the industry might be remedied to a large extent by those responsible for the conduct of the business, or that action taken by producers on an agreed plan might render superfluous some of the measures by which the industry was artificially stimulated.

In 1928 the attempt made to raise prices by organised restriction of production failed owing to insufficient support for the scheme from producers, and last year many conferences were held in Brussels between beet and cane-sugar producers with a view to obtaining concerted action, but the result of the discussions was not made known. A step taken by Cuba during the year was the establishment of a central selling agency for bringing the selling of the whole of the Cuban crop under one control, the object being to avoid pressure of supplies on the markets by making sales gradually and in accordance with the needs of buyers. The agency will have to face competition from the producers outside Cuba, such as Costa Rica and the Philippines, and if this is to be avoided it will mean that the onus of carrying any unsold surplus will fall on Cuba.

The volume under review, which has now reached its seventh edition, is especially intended as an authoritative reference work for those engaged in the industry itself. It will, however, be invaluable to others, especially consultants and industrialists, anxious to know the essentials of cane sugar production in all its stages. All the processes are considered in extreme detail. In addition the control methods, chemical, physical and biological, and the general technique of sugar extraction and refining are gone into with particular care. Reference tables, which will be invaluable to chemists and technologists, are a feature of the *Handbook* and occupy almost a third of the whole volume.

The author of the first six editions of this work was Dr. G. L. Spencer, whose entire career was devoted to sugar chemistry and technology and the last twenty years of his life were spent in commercial work in Cuba and an obituary notice is prefixed by his collaborator to the present edition.

BRITISH INDUSTRIES FAIR.

Appointment of Board of Trade Committee.

The President of the Board of Trade has set up an influential Committee to examine the present situation as regards the British Industries Fair and to consider what means can be adopted to increase still further its utility to British trade.

It is hoped that in the course of their enquiries the Committee will investigate and report on the following questions :—

1. The possibility of extending the scope of the Fair.
2. The date on which the Fair is to be held, and the desirability of holding a second Fair in the autumn.

3. The limitation of participation to manufacturers.

4. The best means of advertising the Fair at home and abroad, and of financing the publicity campaign, with reference to the possibility of raising the money by an addition to the charge for space.

5. The possibility of holding the Fair, or sections of the Fair, at centres abroad.

6. The possibilities of organising a travelling Fair either in ships or trains.

All correspondence should be addressed to the Secretary of the Committee, Mr. A. R. Fraser, M.B.E., Department of Overseas Trade, 35, Old Queen Street, London. S.W.1.

NOTICES OF BOOKS.

Past Climates. By DR. G. C. SIMPSON, C.B., F.R.S. Pp. 34. London: The British Science Guild, 6, John Street, Adelphi, W.C. 1930. Price 1s.

Sir Alexander Pedler, who was hon. secretary of the British Science Guild from 1907-18, and since his death a lecture is delivered annually under the auspices of the Guild and a provincial scientific society to further the work in which he was interested. The lecture delivered at Manchester by Dr. Simpson at the end of last year has now been reprinted by the British Science Guild. It dealt with solar and terrestrial radiation and its effect through past ages.

Messrs. Constable & Co., 10 & 12, Orange St., W.C.2., have just issued a catalogue (84 pages) of their recently published scientific technical books. Among those on Chemistry, Physics and Natural Sciences, are a number of the most important current works on certain branches.

Forthcoming Events.

ROYAL INSTITUTION.

21, Albemarle Street, W.1.

Saturday, March 8, at 3 p.m.—" Atomic Nuclei and their Structure." Sir Ernest Rutherford, F.R.S.

Tuesday, March 11, at 5.15 p.m.—" Science in the Middle Ages." By Dr. Charles Singer.

Thursday, March 13, at 5.15 p.m.—" Some Problems of Genetics." By Mr. J.

THE OPTICAL SOCIETY.

Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7, on Thursday, March 13th, 1930, at 7.30 p.m. The following papers will be presented and discussed:—

(1) " Imagery around a Skew Ray:
Part I, Conjugate points.
Part II. Fourth order matrices for Skew Pencils.
Part III. Sixth order matrices for Skew Pencils."

By T. Smith, M.A., of the National Physical Laboratory.

(2) The Purpose and Design of the New Equipment at the Royal Observatory, Edinburgh." By Professor R. A. Sampson, Sc.D., F.R.S.

(3) " A Description of the Stellar Spectrograph for the 36″ Reflector at the Royal Observatory, Edinburgh." By Messrs. Adam Hilger, Ltd.

(4) " A Description of the 36″ Reflector at the Royal Observatory, Edinburgh." By Messrs. Sir Howard Grubb, Parsons & Co.

UNIVERSITY OF LONDON.

ADVANCED LECTURES IN PHYSIOLOGY.

A course of four lectures on " Chemistry of Muscle in Relation to Problems of Cellular Physiology," will be given at University College, London, (Gower Street, W.C.1.), by Professor Dr. Otto Meyerhof (of the Institut für Physiologie, Kaiser Wilhelm Institut für med. Forschung, Heidelburg), at 5.15 p.m. on Thursday, Friday, Monday and Wednesday, March 6th 7th, 10th and 12th, 1930.

THE INSTITUTE OF METALS.

ANNUAL DINNER AND DANCE.

Owing to the large number of acceptances for the Institute's Annual Dinner and Dance to be held on Wednesday, March 12th (at 6.45 for 7 p.m.; dancing continuing until 1 a.m.), it has been found necessary to *change the venue* from the Hotel Victoria to *the adjoining Hotel Metropole*, where even better accommodation is available, the Dinner being held in one large room and the Dance in another (the old Midnight Follies Ballroom).

The new accommodation being ample, it is possible to issue additional ticke

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

3,905.—I. G. Farbenindustrie Akt.-Ges. — Apparatus for carrying out chemical reactions. February 5.

3,958.—I. G. Farbenindustrie Akt.-Ges. — Manufacture of alkoxybenzophenone di- and tricarboxylic acids. February 5.

Specifications Published.

299,790.—I. G. Farbenindustrie Akt.-Ges. —Dyeing or colouring higher fatty acids.

Abstract Published.

323,080.—Nitrites and nitrates.—Johnson, J. Y., 47, Lincoln's Inn Fields, London (I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany).

Ammonia is catalytically oxidised at temperatures below that at which decomposition of nitrites and nitrates sets in, and at a velocity as high as possible consistent with substantially complete oxidation. The reaction product is brought into contact with a basic substance as soon as possible after leaving the catalyst and without previous cooling. A suitable temperature for the oxidation is 250-255° C.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

COSAVULT.

509,264.—Chemical substances used in manufactures, photography, or philosophical research and anticorrosives.—I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28, Frankfort-on-Main, Germany. February 5. (Associated.)

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A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

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NOTICE TO AUTHORS AND CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

CONSIDERATIONS SUR LA STRUCTURE DU NOYAU DE L'ATOME.

PAR CHARLES JANET.

(*Continué de page* 149.)

REMARQUES SUR QUELQUES POIDS ATOMIQUES.

Emanium.

Si le Radium chimique est extrait d'un minéral contenant, à la fois, de l'Uranium et du Thorium, il est un mélange en proportions très différentes des 4 espèces d'atomes qui composent la pléiade 88 *Ra* et qui sont :

88.*Ra*(46).222, ou *Ac X*
(Filiation *III*, ou de *UY*)
88.*Ra*(48).224, ou *Th X*
(Filiation *IV*, ou de *Th*)
88.*Ra*.(50).226, ou *Ra*
(Filiation *II*, ou de *Io*)
88.*Ra*.(52).228, ou *Mes.Th.I*
(Filiation *IV*, ou de *Th*)

Chacune de ces 4 désignations d'un atome comporte :

le nombre atomique *Z* de la pléiade ou élément chimique,

le symbole de la pléiade à laquelle l'atome appartient réellement,

Entre parenthèses, le nombre isotopique $i = A - 2Z$

le poids *A* de l'atome (nombre de ses protons)

le symbole usuel, de l'atome, dans lequel figure le symbole d'une pléiade en rapport avec la marche de la filiation, mais autre que celle à laquelle l'atome appartient réellement :

la filiation à laquelle appartient l'atome considéré.

Des 4 espèces, ci-dessus, d'atomes composant la pléiade ou élément chimique 88*Ra* (Radium) les 3 premiers donnent, respectivement, par émission d'une radiation α, les 3 espèces d'atomes de l'élément chimique 86 *Em.* (Emanium).

88*Ra*.(46).222 donne 86*Em*.(46).218,
appelé *Ac Em*
88*Ra*.(48).224 donne 86*Em*.(48).220,
appelé *Th Em*
88*Ra*.(50).226 donne 86*Em*.(50)222.
appelé *Ra Em*

Les 8 espèces d'atomes du Radium, non plus que les 3 espèces d'atomes de l'Emanium, ci-dessus, ne penvent être séparées, respectivement, les nns des autres, par les procédés de la Chimie.

Le poids atomique, chimiqne, du Radium, est 225.95 (ou 226), poids qui est bien compris entre les poids isotopiques, extrêmes, 222 et 228, des 4 isotopes de la pléiade du Radium.

Mais on donne, généralement, pour l'élément chimique Emanium (86.*Em*), le poids atomique 222, poids qni doit être un peu trop fort, puisqu'il est le poids moyen d'atomes pesant respectivement 218, 220 et 222.

Si le poids atomique de l'Emanium était, bien réellement 222, il faudrait en conclure qu'il existerait un quatrième isotope inconnu, de l'Emanium, de poids supérieur à 222, provenant, par exemple, de l'atome

88. *Ra*. (52). 228 appelé *Mes.Th.I*
et qui, s'il résultait d'une radiation α, pèserait 224.

DERNIERS ELEMENTS CHIMIQUES.

Parmi les 12 derniers éléments chimiques, dont 10 sont connus et 2 inconnns, il y en a plusieurs, dont de poids atomique, chimiqne, n'est pas établi ou ne l'est pas d'nne façon certaine.

Or, il se trouve que, pour les poids atomiques chimiques, bien établis, de quelques-uns de ces derniers éléments, le rapport

$$\frac{A_c}{Z}$$

du poids atomique, chimique, au nombre atomique, varie peu, et assez régulièrement.

Cela permet de dresser le tableau ci-dessous, dans lequel les interpolations de poids atomiques, mises entre parenthèses ont des chances d'être poids voisins des poids atomiques, chimiques, vrais.

Nombres atomiques *Z*	81	82	83	84	85	86	87	88	89	90	91	92
Symboles des Eléments chimiques	*Tl*	*Pb*	*Bi*	*Po*	*EkI*	*Em*	*EkCs*	*Ra*	*Ac*	*Th*	*Bv*	*U*
Poids atomiques chimiques A	204.39	207.2	209	(212)	(216)	(219)	(222)	222.95	(228)	232.15	(234)	238.17
Rapports A_c/Z	2.52	2.52	2.51	(2.53)	(2.54)	(2.55)	(2.555)	2.56	(2.565)	2.57	(2.575)	2.58

CHANGEMENTS DE COMPOSITION, DES NOYAUX DES ATOMES, DANS LES TRANSMUTATIONS RADIO-ACTIVES.

Quels sont, avec la composition :

Syst. planétaire,

$Z\ (E)^-$

Syst. péri-nucléaire,

$(A - 2Z)\ (E+P)$

Syst. intra-nucléaire,

$Z\ (E+2P)^+ = x(E+2P)^{++} y(2E+4P)^{++}$

que nous avons adoptée, ci-dessus, pour les trois systèmes, d'un atome q uelconque, défini par son nombre atomique Z, et par son poids A les changements qui surviennent, lors des transmutations radio-actives ?

Celles-ci s'effectuent :

1. soit par une radiation α ou émission d'un projectile bipositif $(2E+4P)^{++}$,

2. soit, par une radiation β, ou émission d'un projectile uni-négatif E^-.

Soit, comme exemple de transmutation, par émission d'une radiation α, celle

de l'atome de Thorium 90.*Th* (46).226, appelé *Ra Ac*,

etn atome de Radium 88.*Ra*(46).222, appelé *Ac X*.

Les compositions sont :

$$90.Th.(46).226 = 90\ E+46\ (E+P) + 90\ (E+2P)$$
$$\alpha = 2\ (E+2P)$$
$$88.Ra.(46).222 = 88\ E+46\ (E+P) + 88\ (E+2P)$$

Ainsi, la transmutation, par radiation, α comporte :

1. la diminution du système intra-nucléaire de 2 unités $(E+2P)$.

2. la conservation du système péri-nucléaire,

3. l'abandon, par le système planétaire, de 2 unités planétaires *E*, pour le rétablissement de la neutralité de l'atome.

Cette transmutation, se traduit, par conséquent, (Règle de Soddy) par :

la diminution du nombre atomique *Z*, det 2 unités,

la diminution du poids *A*, de l'atome, de 4 unités.

Soit, comme exemple de transmutation, par une radiation β, qui consiste en un électron-projectile *E*, la transmutation :

de l'atome du Plomb 82 *Pb*.(50).214, appelé *Ra B*.

appelé *Ra C*

Les compositions de ces deux atomes sont :

$82.Pb.(50).214 = 82\ E+50\ (E+P)+ 82\ (E+2P)$

$83.Bi.(48).214 = 8A\ E+4B\ (E\ P)\ 83\ (E+2P)$

On peut supposer que, tout d'abord, l'émission d'un électron nucléaire transforme un groupe intra nucléaire $(E+2\ P)$ en $2\ P$; mais, qu'aussitôt, deux groupements neutres, péri-nucléaires, soit $2\ (E+P)$ pénètrent dans l'intra-nucléus dans lequel on a ainsi, en outre des 81 $(E+2P)$ restants :

$$2P+2\ (E+P)=2\ (E+2P)$$

cet qui porte, de 81 à 83, le nombre des groupements intra-nucléaires, hydrogéniens $(E+2P)^+$

Par consequent, le résultat final est que :

le système péri-nucléaire diminue, de $50(E+P)$ à $48\ (E+P)$

let système intra nucléaire augmente, de $82\ (E+2P)$ à $83\ (E+2P)$

Quant au système planétaire de l'atome, il passe det 82 *E* à 83 *E*, simplement par la capture d'un électron libre, rencontré, capture nécessaire pour établir la neutralité de l'atome, puisque la charge positive du noyau a augmenté d'une unité.

Ainsi la transmutation, par radiation β comporte :

la diminution du système péri-nucléaire det 2 groupements neutres $(E+P)$,

l'augmentation du système intra-nucléaire de 1 groupement positif $(E+2P)^+$, et par consequent, conformément à la Règle de Russell, Soddy et Fajans (1913) comporte :

l'augmentation du nombre atomique Z d'une unité,

la conservation du poids *A* de l'atome.

HYPOTHESE DE LA GENERALITE DES DESINTEGRATIONS RADIO-ACTIVES.

Ce n'est pas faire une hypothèse absolument dépourvue de tout fondement, que de considérer, comme possible, que tous les éléments chimiques puissent se désintégier, spontanément, par le processus de la radioactivité. Ce serait une hypothése utile à l'explication d'un évanouissement final, total, des atomes, dans l'évolution cyclique des étoiles.

Pour qu'il puisse en être ainsi, il suffirait d'admettre que cette radio-activité nous échappe, à cause de sa lenteur et de la faiblesse de ses manifestations énergétiques.

On peut donc se demander ce que deviendrait un atome quelconque, autre que ceux dont la radio-activité est connue, dans le cas où il se désintégrerait, et on est ainsi conduit à envisager 3 cas :

1. Désintégration par émission d'une radiation β ou projectile *E*—,

2. Désintégration (sans exemple connu) par émission d'un projectile hydrogénien uni-positif, de poids 2, et de composition $(E+2P)^+$

3. Désintégration par émission d'une radiation α ou projectile hélien bi-positif, de poids 4, $(2E+4P)^{++}$

Si l'on prend, pour exemple, l'atome de l'Oxygène

$$8.O.(0).16 = 8E+0(E+P)+8(E+2P)$$

celui-ci se trouve diminué det

à = $2(E+2P)$

et, pour rétablir la neutralité, de

$2E$ (planétaires)

Il en résulte un atome de Carbone

$$6.C.(0).12 = 6E+0(E+P)+6(E+2P)$$

Quant à la transformation β, elle paraît être *impossible, car elle exigerait la présence* d'un système périnucléaire, qui semble faire défaut chez l'Oxygène.

L'atome neutre du Fluor

$$9.F.(1).19 = 9E+1(E+P)+9(E+2P$$

par émission d'une radiation α $2(E+2P)$ et, pour maintenir la neutralité, par abandon de 2 électrons planétaires,

$2E$

donnetrait l'isotope inconnu de l'Azote

$$7.N.(1).15 = 7E+1(E+P)+7(E+2P)$$

Le poids atomique, chimique, de l'Azote étant 14,008, il est possible qu'il existe un tel isotope de poids 15, très peu abondant.

Mais, l'atome du Fluor ne pourrait pas fournir la radiation β, parce que celle-ci exige un système péri-nucléaire composé, d'au moins, 2 groupements $(E+P)$ et que l'atome du Fluor ne comporte qu'un seul de ces groupements.

Pour le potassium, qui comporte 2 isotopes :

$$19.K.(1).39 = 19E+1(E+P)+19(E+2P)$$
$$19.K.(3).41 = 19E+3(E+P)+19(E+2P)$$

l'émission d'une radiation β ne peut pas être fournie par l'isotope (1) qui ne possède qu'un *groupe péri-nucléaire* $(E+P)$ *non plus* probablement, que par l'isotope (3), car celui-ci donnerait

$$20.Ca.(1).41 = 20E+1(E+P)+20(E+2P)$$

qui, n'est pas l'un des isotopes connus, ceux-ci étant

$$20.Ca.(0).40 = 20E+1(E+P)+20(E+2P)$$
$$20.Ca.(4).44 = 20E+4(E+P)+20(E+2P)$$

Quant à l'émission d'une radiation α, par les 2 isotopes du Potassium elle donnerait, respectivement les deux atomes du Chlore.

$$17.Cl.(1).35 = 17E+1(E+P)+17(E+2P)$$
$$17.Cl.(3).37 = 17E+3(E+P)+17(E+2P)$$

qui sont, précisément, les deux isotopes du Chlore, reconnus comme réels.

Transmutation par Emission d'un Projectile Hydrogenien (E+2P)+

Si, la désintégration spontanée est une propriété générale de tous les noyaux atomiques, la composition que nous attribuons à ces noyaux suggère de considérer, comme possible, bien qu'on n'en connaisse aucun exemple, une désintégration par émission d'un groupement hydrogénien uni-positif, de poids 2, $(E+2P)^{+}$, moitié du groupement hélien $(2E+4P)^{++}$.

Dans ce cas, l'atome d'Oxygène

$$8.0.(0).16 = 8E+0(E+P)+8(E+2P)$$

se réduirait par émission de

$1(E+2P)$

et, (pour maintenir la neutralité) d'un élec *tron planétaire*

Il en résulterait un atome d'Azote

$$7.N.(0).14 = 7E+0(E+P)+7(E+2P)$$

Par un processus similaire l'atome d' Azote

$7.N.(0).14.$

donnerait l'atome de Carbone

$6.C.(0).12.$

Ce serait l'inverse de la genèse intégratice des atomes, puisque nous supposons que cette genèse s'effectue, précisément, par intégration de sortes de quanta complexes, constructifs, uniformément égaux au groupement hydrogénien, uni-positif, de poids 2 ayant pour composition $(E+2P)^{+}$.

Desintegration Artificielle des Noyaux.

Au moyen du bombardement, par les projectiles α rapides, $(2E+4P)^{++}$, fournis par la désintégration radio-active, spontanée, des atomes de poids 214, de la pleiade du Bismuth, appelés Radium C (Atome 83 Bi 214, *Ra C*), E. Rutherford a obtenu une désintégration des noyaux des atomes, de plusiers des éléments chimiques légers, jusqu'au Potassium 19*K*.

La désintégration n'a pas pu être obtenue pour

le Lithium,	3*Li*
le Beryllium,	4*Be*
le Carbone,	6C
l'Oxyégne,	8O

Pour déceler la présence des protons expulsés, et pour mesurer leur parcours, Rutherford emploie la méthode des seintillations.

D'après la composition que nous attribuons au noyau de l'atome, le groupement qui fournit le proton *P*, expulsé dans les ex*périences de Rutherford, ne* peut être que l'un des groupements $(E+P)$ ou $(E+2P)^{+}$ ou $(2P+4E)^{++}$; mais, il est probable que ce *n'est ni* $(E+P)$ *ni* $(2E+4P)^{++}$, mais bien $(E+2P)^{+}$ qui émet les protons en question.

La décomposition de ce groupement $(E+2P)^{+}$ peut donner le groupement neutre $(E+P)$ et un proton *P*. Le groupement $(E+P)$ peut être utilisé, dans le système péri-nucléaire (s'il s'agit d'un élément

chimique qui en comporte), tandis que le proton P est expulsé.

On peut supposer, aussi, que le groupement $(E+2P)+$ est désintégré, totalement, en deux protons qui sont expulsés et en un électron libre, qui peut être capture par le système planétaire.

Si le groupement éliminé est bien $(E+2P)+$ et si le projectile désintégrateur $(2E+4P)++$ etst capturé par le noyau intéressé, on a une transmutation telle que celle, de l'intra-nucléus d'Azote

$$7(E+2P)=3(2E+4P)+(E+2P)$$

en intra-nucléus d'Oxygène

$$8(E+2P)=4(2E+4P)$$

lequel, d'après les expériences, paraît être difficilement transmutable ou, même, non transmutable, par le bombardement α. Mais alors, il s'agait, non pas d'une transmutation désintégratice (qui se présente si le projectile $(2E+4P)++$ n'est pas capturé) mais, au contraire, d'une transmutation intégratrice.

Le système planétaire retiendrait, dans ce cas, l'électron fourni par la désintégration complète du groupement hydrogénien $(E+2P)+$.

(*à Suivre*)

MATTER AND LOGIC.

By DR. W. TOMBROCK.

The Ether of Mendeléeff. II.

I must begin here with a passage in which Mendeléeff speaks of a conception of Sir William Crookes (loc. cit. p.14), " It does not require the recognition of a peculiar fourth state beyond the human understanding (Crookes)."

The ether of Mendeléeff must resemble a *gas* : " The only addition made is to ascribe to ether the properties of a gas, like argon and helium, utterly incapable of entering into true chemical combination." (*loc. cit.* p.15.). We shall later consider the conception of Crookes referred to.

The *simplest*, least hypothetical conception of ether, in our chemical routine of thought, is that it consists of small, single particles which move as gas molecules move —we point out once more the striking analogy between light and sound. But the ether is still not a gas as a result of this; at any rate not a really chemical gas with complex atoms. Apart from the marked difference in distribution between the ether and gases such as argon and helium, a difference which from the nature of the case can be considered as nothing essential, it is, however, certain that the *ether has no detectable spectrum* and also that, apart from the technical impossibility of it, nobody is likely to think of liquefying the ether. We are obliged for the sake of the simplest, least hypothetical explanation, after our chemical routine, to assume the ether atom to be simple, thus not complex, hence not a true chemical atom, which is really complex and which reveals itself in a spectrum, but an atom in the original sense of the word, an atom, such as we may suppose Democritus conceived it. The thought of liquefaction is difficult to associate with such an atom; condensation and rarifaction can be readily understood, but not liquefaction, however before a greater complexity has come into existence in the atom. For the sake of the least hypothetical explanation, in the chemical sense of this word, the ether must thus *lack* the specific, characteristic properties of a gas; the ether is then *not* a real, although inert gas; even though the ether particles or atoms move as gas molecules move . . . thus the ether is not a *true* gas, still less a liquid and least of all a solid substance, in virtue of its observable or rather its negative properties. And that Mendeléeff did not perceive this is due to an error in his way of reasoning which, in my opinion, seeks *too much by analogy* and takes too little account of what has been empirically established and which may be taken as a starting point . . . the fact, that the ether is, even experimentally, unobservable to our senses. But in his days of being Mendeléeff could hardly start from this standpoint.

We shall not go into this further *now*, perhaps we may later incidentally once more indicate this fault, but let us now rather consider more closely the arguments by which Mendeléeff shows that the ether ought to be a gas.

We cannot, however, omit to determine what Mendeléeff thought about the unit of matter and its origin from a primary form (*loc. cit.* p 7) " According to this view, ether consists of this primary matter in an unassociated form, that is not in the form of the elementary atoms or molecules of substances, but as the constituent principle out of which the chemical atoms are formed. *This view has much that is attractive.*" But Mendeléeff does not agree with it (p.10) " for it seems to me that, besides being chemically invalid, it is impossible to conceive of ether as a primary substance, because such a substance should have some mass or weight and also chemical relations —mass in order to explain the majority of phenomena at all distances up to the infinitely great, and chemical relations in order to explain those proceeding at distances infinitely small or commensurable with the atoms."

Here, however, Mendeléeff overlooks one thing, namely the maxim which we attribute to Bacon, *i.e.*, *that further and more complicated properties first come into being with a greater complexity of the material aggregates.* As a result of this it is possible that some properties of matter come into being or become observable first with chemical atoms, molecules, etc., while the ultimate, simple particles of the " primary matter in an unassociated form " lack these properties or at any rate do not show them.

Somewhat further on Mendeléeff then continues : " The necessity of an easy and perfect permeation of all bodies by the ether has to be admitted, not only for the comprehension of many physical phenomena (such as those of optics), but also owing to the great elasticity and rarity of ethereal substance, the atoms of which are always conceived as being far more minute than the atoms and molecules of the known chemical substances. Moreover, this permeability of ether in all bodies explains why it cannot be isolated from substances which indeed behave in this respect to ether like a sieve to water on air. *The capacity of the ether to penetrate all substances may, however, be regarded as the diffusion of gases through metals and other diaphragms.*"

Mendeléeff then mentions hydrogen and points out platinum and palladium, which are impervious to other gases ! He points out that the considerable penetrating power is to be attributed not only to its small molecule and the swift movement of the latter " but also to a chemical faculty of the same kind as is exhibited in the formation of metallic hydrides, of solutions, alloys and other indefinite compounds."

Further on Mendeléeff comes to the following conclusion : " If, as it must, ether has the faculty of permeating all substances, it must be even lighter and more elastic (greater *vis viva*) than hydrogen, and, what is most important, *must have a less capacity than hydrogen to form chemical compounds with the bodies it permeates* (*loc. cit.* p.12).

We willingly agree with this but as far as we are concerned it does *not* follow from this that the ether cannot then be a " primary " matter, quite the contrary! The formation of chemical compounds is indeed connected with constituents of the chemical atoms, the *protons*, and cannot longer be conceived without these. Thus there must *first* be protons, before the faculty of entering into chemical combinations can make its appearance. But protons are not formed at the slightest provocation, still less disintegrated at any trifle. Everything points to this. Very special circumstances are necessary to form protons from " primary matter." Protons are—according to our idea —rather to be compared to tornados in the atmosphere than to a little whirlwind which drives the autumn leaves round the square of a little country town. The proton must be for its kind, much more powerful than a tornado and is also much more stable. And in view of the fact, that the rapid formation of protons is certainly not plausible, the conclusion that the ether, being conceived as " primary matter " must reveal itself chemically, carries little conviction to us. Ordinary ether particles would not have to influence the character of chemical configuration. *Granted* that the protons first do this. And it is *possible* that the heavier simple material particles—for as such we consider the electrons—also do this (one may consider the case of helium). Consequently the ether being conceived as a gas with simple Democritean atoms may at the same time be regarded as " primary matter," out of which, *under special circumstances*, the protons are to be formed, without postulating the conclusion that it should reveal itself chemically — as Mendeléeff has it.

Let us now follow Mendeléeff further. He points out a possible compound of hydrogen and palladium (" either Pd_2H or another) which easily dissociates when heated. Hence it seems to me that the atoms of ether are so void of this faculty of forming compounds (which is already weak in hydrogen) that such compounds dissociate at all temperatures, and that therefore nothing beyond a certain condensation among the atoms of substances can be looked for in the ether." (p.13). Mendeléeff then writes this in 1902 :—

" Eight years ago it would have been most arbitrary to deny the existence, in the substance or atoms of ether, of the faculty of forming any compounds with other chemical elements, for in those days all the known elements were, directly or indirectly, capable of entering into neutral combination. But in 1894 Lord Rayleigh and Professor Ramsay discovered argon, and defined it as the most inactive element; this was followed by the discovery of helium, the existance of which Lockyer had predicted by its spectrum as a solar element and subsequently by the separation of neon, krypton and xenon from the air. None of these five new gases have yet given any definite compounds although they clearly evince the faculty of solution, *i.e.*, of forming indefinite, easily dissociated compounds. Thus we have now

every right to say that ether is unable to form any stable compounds with other chemical atoms, although it permeates all substances."

You thus see that, according to Mendeléeff, an old prejudice against a comprehensible, ordinary, material, *gaseous* state of the ether (which however according to *theoretically unprejudiced* induction and logic is of itself the most acceptable) is removed by the famous discoveries of Ramsay and his collaborators.

Mendeléeff theu continues : " Hence *the ether may be said to be a gas, like helium or argon, incapable of chemical combination.*" He then goes into the consequence of this definition :—The recognition of the ether as a gas, signifies that it belongs to the category of the *ordinary* physical states of matter, gaseous, liquid, and solid. It does *not* require the recognition of a *peculiar fourth state beyond the human understanding* (Crookes) " (*loc. cit.* p.p.13-14).

This conclusion is almost implicit in the argument of Mendeléeff. He, however, once more overlooks the fact that the ether atoms, for the sake of the least hypothetical conception being considered as a simple particle, thus not complex, thus as a real Democritean atom or approximately so, has no spectrum and may also lack other specific gaseous properties, such as, for example, condensability (liquefaction). A gas with such discrepant properties therefore, that the idea of a fourth state of matter, even if it is *not* the one Crookes thought of, is not only defensible but also becomes very plausible when one would assume, as we do, the theoretical possibility that under very special circumstances, all matter, all gases thus, can also change into ether. (One may here be reminded of Millikan's cosmic rays). But now Mendeléeff was once against an ether as " primary matter " for other substances. He did *not* keep in mind the maxim attributed by us to Bacon that more complicated material properties first make their appearance with greater complexity of the substance.

We hope to return to Crookes' " fourth state " again at some later time. We only remark that with the removal of the objection to a gaseous ether to which Mendeléeff draws attention, the same objection against *our* ether disappears; we postulate our ether indeed to be also a *gas* (with Democritean atoms !).

There are still other objections to get rid of, also in connection with this discussion

does not think of the *transversability of the light-waves (polarisation)*? We shall also face this objection later on. We will finish this time with two fundamental propositions formulated by Mendeléeff (*loc. cit.* p. 15) :— " (1) that the ether is the lightest (in this respect ultimate) gas, and is endowed with a high penetrating power, which signifies that its particles have, relatively to other gases, small weight and extremely high velocity, and (2) that ether is a simple body (element) incapable of entering into combination or reaction with other elements or compounds, although capable of penetrating their substance, just as helium, argon, and their analogues are soluble in water and other liquids."

With this we may be permitted to point out yet the difference and agreement between the idea of Mendeléeff and ours :—Mendeléeff *considers the ether to be a gas as, for example, helium and holds it to be impossible that the ether can then be " primary matter " from which other elements are built up—we consider the ether as a gas with Democritean atoms and as " primary matter " from which the protons and from these the chemical elements can, under very special circumstances, be produced. Furthermore we may emphasise that whereas Mendeléeff explains the chemical inactivity of the ether by its likeness to argon, neon, etc.,* we *explain this property by its being " primary matter in an unassociated form."*

Bergen op Zoom,
Holland.
February, 1930.

" WHY NOT FOREIGN CHEMICAL PLANT ?"

A discussion on the above subject took place recently, under the auspices of the British Chemical Plant Manufacturers.

Mr. H. Ballantyne opened by saying that the firm of Lever Brothers, with which he was associated, was looking forward to an increased amount of business and to increased points of contact with British chemical plant makers, and that the Association represented an industry of vital importance to the well-being of Levers and the chemical industries generally of this country. As to the question to be discussed, he held no brief for the foreign manufacturer of

and honest they must admit that there was much to be admired in the work of their foreign competitors. Those who had opportunities of visiting chemical works on the Continent would agree that, as regards the quality of the plant and the chemical engineering layout of that plant, the Continental manufacturers were second to none. It did British plant makers no harm to recognise that fact. The real answer to the question must be given by the members of the Association, but in considering it, it would be wise to divide chemical plant into three categories to which different considerations applied—first, the ordinary standard type of plant to which competitive conditions applied; secondly, speciality plant, which was either patented by the owners or for other reasons a virtual monopoly of individual companies; thirdly, new forms of plant designed to meet the special requirements of particular manufacturers.

With regard to the first, an all-important consideration was the question of cost. Users of plant could not overlook that factor, and he thought it would be agreed that in many respects this class of plant was produced more cheaply on the Continent than in this country. It did not follow that cheapness was the sole or dominant consideration as to whether we should import it, but if we compared the price of a particular piece of plant bought and delivered in England with the price of similar plant bought and delivered on the Continent, the difference would often be found to be striking. Members of that Association were already studying that problem very carefully and no suggestions from an outsider were likely to assist them very much. He was, however, struck very much by the warm way in which Colonel Pollitt last year recommended the pooling of sources and the amalgamation of small concerns—a course which the speaker thought likely to prove of great value.

As to the second class of plant, it was hardly worth while putting the question, because competitive conditions did not apply to the same extent, and it was usually a question of taking it or doing without. He had observed what seemed to him a greater capacity on the part of the foreign maker of this type of plant to acquire inside knowledge of the needs and the business of the purchaser, and also greater readiness to take some risks in offering plant for trial and carrying out the work during the period of trial. Possibly, there might be something for the British manufacturer to learn in that respect. In this type of plant, the American took the lead in automatic and other machinery for production on a large scale, but apart from that the British and Continental firms stood very much on the same plane.

With regard to the third class, the question raised the delicate point as to the relations between manufacturer and purchaser in the matter of confidential information. There was no real guarantee of secrecy for the purchaser beyond the probity and character of the manufacturer, and in this respect the British chemical plant manufacturer was pre-eminent. He could be trusted not to give away their secrets and not to make use of the results of joint efforts in working out the plant. He did not think that the same could be said of the Continental maker, at least to the same extent.

Recently his company had designs prepared for plant required by one of their associated companies and they sent detailed drawings to five different manufacturers on the Continent. Number one got the order. The day after he got their business, he applied for a patent, and the specification proved to be an exact copy of their particulars. When the repeat orders came to be due it was pointed out that his patent was valueless because the whole substance of the specification had been previously disclosed to four of his competitors.

He did not wish to disparage foreign manufacturers in general, but incidents of that kind did make purchasers in this country a little more careful and might turn the scale in favour of the home maker, where new ideas had to be incorporated. In the case of this type of plant, his opinion was that the purchaser should give as clear a description as possible of the requirements to be met, and when the plant was being tried out to allow a reasonable latitude to the manufacturer to get over the difficulties that usually cropped up. His company considered that a larger co-operation between the buyer and maker of plant was almost invariably justified. In that respect, he was not in complete agreement with the suggestion

which might be read into the report of the discussion at the last annual dinner —that the plant manfacturer ought to be expected to lay down a new unit for a new purpose with complete success on its first trial runs; in many such cases neither buyer nor maker could foresee all the conditions which might arise or all the difficulties which might crop up.

Dr. Levinstein stated that there had been an enormous advance in the design of chemical plant and in the character of the manufacturers of chemical plant since the war. This had been one of the powerful factors in the recent development of chemical industry in this country. He congratulated the Association on the great progress that had been made in recent years and on the courage with which they were facing their problems.

Mr. F. C. Fairholme (Thos. Firth and Sons, Ltd.), said that in such minor matters as laboratory glassware, we were dependent upon the foreign manufacturer for our supplies before the war, and when war broke out we realised our sense of dependence as we had never done before. Sheffield University had undertaken some very valuable research into glassware and had been able to assist British manufacturers of chemical glassware to produce an article that to-day was really better than that produced by the foreigner. Was not that also an argument for encouraging the home manufacturer of chemical plant?

The question of purchase of foreign plant was a general problem and a somewhat difficult one. He thought the purchaser should give to the home maker an opportunity of ascertaining whether and in what respect the foreign production was better than his own. He suggested, further, more co-operation in this country in order that the supplies of materials for plant might have an opportunity of knowing exactly what was wanted and what the conditions were that the plant had to meet. It had always been very difficult to ascertain this information and it was difficult still in many cases. Such co-operation led to opportunities for the research that was so necessary, and he was glad to find the attitude of the British chemical industry increasingly favourable to this idea.

(To be continued.)

THE CHEMIST AND COMMERCE.

The Institute of Chemistry's First S. M. Gluckstein Memorial Lecture, December 13, 1929.

By Leslie H. Lampitt, D.Sc., F.I.C.

(Continued from page 155.)

Mass production, with all its limitations, has given a wonderful opportunity to the chemist, because mass production and the repetitive operation can be controlled. In this connection, I would issue a word of warning against complicated control. It is most essential to study the process which has to be controlled, to pick out the more salient points, and to bring down your routine analyses to the absolute minimum. This is necessary for two reasons; firstly, the question of expense—I need not labour this; but secondly, if control is to be of effective use, the results must be available with the least possible delay and, therefore, methods of analysis must be adapted to the object in view. The chemist starts off in such cases with a knowledge of the raw materials, and it is, therefore, probably only necessary to check off from time to time during the process one or two factors which are indicative of the change taking place. You have also to judge the accuracy demanded by the process; in other words, it is no use carrying out determinations to the second place of decimals in a per cent., if other factors in the process are such that one or two per cent. variation is unavoidable.

The chemist it is who must be prepared in cold blood to put his ideas to the test. Are they day-dreams, or visions that can be realised? If the latter, then he can, with a clear conscience, place them before those who control the "educated money" prepared to press for them with all the strength of his convictions. In this connection, I would say—"Never put before those in authority anything in which you have not whole-hearted faith." The business man hates indecision: he would much rather agree with, or combat, your considered ideas than be left without a definite lead.

A chemist's work is always with him. He cannot leave it in the laboratory, because it is essentially a work of the mind, and the chemist who stops working when he turns out the Bunsen is not likely ever to be fit for anything but turning Bunsens on and off. No, he must do his practical work by day, and his thinking by night. Chemistry must not be his work; it must be his life.

There are many men in chemistry to-day who are not chemists by instinct. At a time when it was necessary for them to decide on a career, someone mentioned to their fathers or mothers that there were good openings in chemistry : they might just as well have heard that there were good openings in architecture or dry goods, engineering or baking, in accountancy or shipping; and so there were. It is equally true that there are only a few men who are particularly fitted to be architects or bakers, or engineers, or dry goods men, or shippers. So the man became a chemist; he drifted into chemistry. But even this man can make for himself a definite niche in the world of chemistry. Although it may not be his life, he can do well; he can raise himself above his fellows, not because he cannot help himself, but because he does help himself.

Report on all your work, and I most strongly urge that all reports should be written. The definite records prevents, or should prevent, rash statements : and furthermore, *it may be required as evidence in* the future. The chemist may make mistakes—admit them : before doing so, however, make sure they are yonr own. Besides, it gives those above you a chance to appreciate the fact that the chemist is human. You may deserve blame, but, on the other hand, dont expect praise. To achieve the impossible appears to be, in the minds of many people, regarded as a prerogative of the chemist, but it is a decided compliment to us, although it often has an embarrassing effect.

All investigational work should be carried out with an object : the object may be an immediate one or it may be a purely fundamental one; but, in the latter case, the basic problem should bear a definite relationship to the needs of the firm.

Endeavour to publish your work from time to time—for publication is a salutary thing. You may be perfectly satisfied with some of your work; but prepare it for publication, look upon it as you would upon that of someone else, and you will probably *find many little points, which are not so* satisfactorily proven as you had imagined.

The chemist must be sure of his facts : he wmust make no guesses. Not only is this to nportant in general, but, in the case of the the tmist in commerce, there is the added to acqubility of a clash between chemists—and the vokers being not merely the scientific public, but commercial people with financial interests at stake. Therefore, whenever you have to dispute such things as, for example, the quality of raw materials, be sure of your facts. Search the literature and, so far as is practicable, confirm in your own laboratory statements made. Be so sure of yourself that you are always willing to demonstrate to the other side the methods you have used and the data on which you have based your findings.

The relationship between the chemist and the technical staff is naturally of the utmost *importance, and one which will have* largely determined the actual position of the chemist in any commercial undertaking, although it is naturally impossible to lay *down any hard-and-fast ideas.* The individual's feelings must be subservient to the object in view, namely, the good of the business; but all means must be used to get that co-operation which is absolutely necessary before the full influence for good which the chemist can exert in commerce is to be obtained.

Invite criticism by the technical staff. They will criticise yon in any case, so do all you can to get them to criticise openly. Remember that it does good, and that they get just as much pleasure out of it as you do when you criticise them.

Mr. Gluckstein said : "Do not be satisfied to work in your laboratory only, be as expert in practice as the practical man." I cannot stress this point too strongly. How much time, energy, and money have been wasted by chemists working on a process which they did not thoroughly understand. For this, I blame the chemist as much as the factory man who, probably not realising the importance of various factors, did not tell the whole tale relating to the process. So the chemist must rely upon himself to find out the whole circumstances. I consider one of the main causes of any such success as the Lyons Laboratory may have achieved is due to the principle agreed upon, at the very *inception of our scientific* venture—namely, that the Laboratory staff be as fully informed as possible with regard to all circumstances concerning the problems *submitted to it, and be given every facility* to explore the processes as carried out by the firm by actual contact with the factories themselves. And here again no cursory examination is sufficient; it is nearly always the minutiæ of a process which count, and these details can only be realised by a painstaking effort on the part of the chemist. He must be content to stand by and watch a

process through, not once, but many times, and must correlate such data as weights and temperatures and time with the final product.

The mention of factories and processes brings me to another point, which I regard as of prime impoitance. No matter now great your firm, no matter how perfect your process, embrace any opportunity which may come your way to inspect processes and factories of other people, not with the spirit of spying out their secrets—and here I suppose there are firms with secrets, but in my experience they are secrets chiefly in the minds of those working them—but with a candid desiie to appreciate what other people are doing. But, of course, you must see that your own firm will reciproeate. This brings about an interchange of ideas which must be of mutual advantage. There is in Eugland too much fear that a visitor will take away that one idea from a factory which gives it the advantage over its competitor; the obverse is apparently too often forgotten.

Finally, may I conclude what may be regarded as a compilation of somewhat rambling statements of a pseudo-philosophical nature, with a word regarding the critical faculty. I wish to stress this point because I feel that it is of immense impoitance. Develop a critical outlook on all the products and processes of your firm, but let your criticisms be fair. Above all, be critical of your own suggestions; do not be afraid to admit that a process or a product, which has been brought into being by yourself, is poor, or, on the other hand, claim that it is so good as to be incapable of improvement; and meet the criticisms of others with a fair and open mind. Remember that you have not the monopoly of the desire to see your firm advance. This is commou to all, so receive any criticisms of your processes in the true spirit of co-operation.

The way of the chemist in industry is, on the whole, a way of tribulation, but the victory goes to the strong; the law of the survival of the fittest has not yet been proved totally erroneous. Therefore, because I have every faith that the chemist will assume a far greater position in the commercial world in the near future, I say —" Make yourselves strong in knowledge, make yourselves fit to administer, and so develop those characteristics which will enable you to take your place as chemists in the commercial world of to-morrow."

SCIENTIFIC RESEARCH AND THE RAILWAYS.

At the annual meeting of the London, Midland aud Scottish Railway on February 28th, Mr. Josiah Stamp, G.B.E., the chairmau, said that the process of amalgamation of the railways brought into one system a number of scientific laboratories engaged in the testing of materials, metallurgical investigations and kindred scientific work, and the late Mr. Reid did excellent work in rearranging the functions of these various laboratories and reorganising them. I have for some time been greatly impressed by the possibilities of research, having regard to the large quantities of materials of all kinds used by us and the immense variety of processes involved. Some months ago I appointed a committee to consider the suitability of our present arrangements to their present task, and the scope for further research upon definite and co-ordinated lines, and particularly the relationship existing between the experimental testing in shops, the laboratory work and the work of the outside research associations with which we are affiliated. On this committee I had the help of some eminent men in the scientific field and in the world of industrial research. The report of the committee was gratifying from the point of view of the excelleuce of the work now being done by our scientific staff, and the arrangements in the laboratories. They were favourably impressed by the high standard attained in the work and by the large amount of research in improving existing processes and developing new methods. But they confirmed our view that considerable scope existed for further intensive directed research, and recommended the appointment of an officer with special attainmeuts, for co-ordinating the work and securing the uecessary contracts between the Railway and Associations or Industrial Laboratories, together with the assistance of an advisory committee.

We are now well on the way to carry out the recommendations of this committee, and the present personnel of the advisory committee, who will meet from time to time to consider the programmes of research and their progress, will he, under Sir Harold Hartley as chairman. Sir Harold Carpenter, F.R.S., Professor of Metallurgy in the Royal School of Mines; Sir Herbert Jackson, K.B.E., F.R.S., Emeritus Professor of Chemistry

and director of the British Scientific Instrument Research Association; Mr. W. Rintoul, Joint Research Manager of Imperial Chemical Industries, Ltd.; Dr. Frank Smith, C.B., C.B.E., F.R.S., Secretary of the Royal Society and *Secretary to the Department* of Industrial and Scientific Research, together with certain of our own technical officers. These gentlemen have all a very cordial interest in the development of research along the lines I have indicated, and I have to express my deep appreciation to them for their willingness to assist and the public spirit they have shown.

GENERAL NOTES.

OVERSEAS TRADE.

The *Commercial Secretary to the Residency*, Egypt, reports that the Survey of Egypt is calling for tenders, to be presented in Egypt by the 3rd May, for the supply of rolls of sensitive paper and photographic chemicals.

Firms desirous of offering paper and chemicals *of British manufacture* can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference number B.X. 6204 should be quoted.

DISTANCE ELECTRICALLY CONTROLLED STEAM VALVES.

An Important Development for Chemical Works.

By a Well-Known Engineer.

More and more there is now being used in large power stations the principle of "distance" electrically controlled steam valves. The advances in this field are also of great importance from the chemical engineering point of view, enabling all kinds of valves for steam, gases, compressed air, water, and liquids generally, to be controlled from a central panel any distance away. In this new field prominent are Hopkinsons, Ltd., of Huddersfield, who have devoted special attention to the subject for several years past in their experimental and research departments. Incidentally also they have supplied a large number of special high pressure steam and gas valves, up to 800 lbs. per square inch, to Synthetic Ammonia and Nitrates, Ltd., of Billingham-on-Tees.

The Hopkinson electrically controlled valve consists essentially of the [valve] itself, a small self-contained electric motor, often fixed on the top, an arrangement of limit switches, and the necessary wiring to a central control panel, any distance away, so that the valve is opened, closed, or stopped at desire intermediate point, merely by operating a switch or pressing a button on the panel. Any desired number of valves are connected up in this way and in each case an indicator is included so that the exact position of each valve as regards opening or closing can be seen at a glance. The advantages are obvious, and, for example, when necessary any or all of the valves can be closed down instantly whilst the circuit may include a series of auxiliary emergency panels at desired points. Also for very large valves and high pressures, the use of an electric motor is much superior to slow and laborious hand operation with reduction gearing. The valves themselves are of the firm's well known designs, suitable for any conditions of up to 1,800 lbs. per square inch pressure, and 1,000 degs. F. temperature, and in this latter connection special valves will be supplied to the Delray No. 3 station, Detroit, operating with the highest degree of superheat in the world, when also using pressure, as distinct, of course, from merely heating steam under more or less atmospheric conditions. The small motors used are either A/C or D/C, and the limit switches have no trigger devices, while any type of valve is closed down dead tight on its seat, without any supplementary hand operation. The panel arrangement can also be exactly as desired according to circumstances, one general arrangement being an indicator and three press buttons for each valve on the panel, for "shut," "open," and "stop," that is leaving the valve in any position.

With these buttons also, when once pressed the action completes itself and the button then returns to its former position, indicating the whole circuit is in order. Many other refinements in design are included to ensure efficient operation, for example, including a series of interlocks to ensure impossibility of damage if the wrong button is pressed. Also each valve can be hand operated, as usual since the motor automatically disconnects itself if not running. Large steam power plants are, of course, the best example of such methods, but the importance for many chemical operations is obvious, one example being the Bergius process of hydrogenation with the huge high pressure steel bombs operated on these lines at a safe distance away.

GREAT SLAVE LAKE HAS INTERESTING GEOLOGICAL FEATURES.

The Geological Survey of Canada has been, since its organisation in 1842, among the most active of government departments in carrying on exploratory work, and much of our knowledge of the geology, physical features, and natural resources of the less accessible parts of the country has come from these activities. Surveys of a detailed character are made of the less remote areas, and it is the policy of the Geological Survey to keep this detailed work well in advance of the northward sweep of industrial development. In pursuance of this policy it sent a party under Dr. C. H. Stockwell to investigate during the summer of 1929 the geology and mineral possibilities of an area underlain by Precambrian formations around the east end of Great Slave Lake in the Northwest Territories.

Little had been known previously about the geology of this area except what had been generously given to the public by mining engineers engaged by a private company during the summer of 1928. The investigations of these engineers showed that the area is underlain by geological formations of great interest.

Mr. Stockwell found that the oldest rocks in this section appear to be chiefly granite and granite gneiss which form a high ridge along the southern border of the area, and form a basement upon which a younger series of rocks are deposited unconformably. These younger rocks are divisible into two main groups, the older of which is a thick sedimentary-volcanic series composed of conglomerate, quartzite, chert, argillite, slate, iron formation, arkose, schist, greywacke, limestone, sandstone, shale, andesite, rhyolite, quartz porphyry and greenstone. This series occurs in all attitudes from nearly flat lying to steeply dipping folds and is intruded locally by batholithic rocks with a composition approaching that of syenite. The younger group is in unconformable contact with these rocks, is flat lying or less severely folded, and noticeably less metamorphosed. Lithological types include conglomerate, sandstone, shale and amygdaloidal lava flows. The youngest consolidated rock in the area is diabase in the form of dykes and sills with well developed columnar jointing and forming prominent topographical features.

Proceedings and Notices of Societies

ROYAL INSTITUTION.

At a General Meeting of the members of the Royal Institution held on March 3rd, Sir Robert Robertson, Treasurer and Vice-President, in the Chair, it was announced that the Managers had that day elected Mr. J. B. S. Haldane Fullerian Professor of Physiology, in succession to Dr. J. S. Huxley. Dr. F. H. Carr, Mr. R. E. Clay, Mr. H. M. Dunkerley, Mr. H. R. Fry, Professor F. L. Hopwood, Mr. A. W. Isenthal, Mr. N. C. Neill, Lady Saltoun and Miss E. Watt were elected members. It was announced that the Friday evening discourses after Easter would commence on May 2nd, when Mr. H. E. Wimperis will give a discourse on "A Study of the Phenomenon of Spin in Airplanes." Successive discourses will probably be given by Professor J. Garstang, Dr. C. M. Yonge, Mr. R. S. Whipple, Sir H. C. Harold Carpenter, Professor H. Clay and others.

NOTICES OF BOOKS.

Elementary Chemistry. By A. SUTCLIFFE, M.A., B.Sc. Pp. viii + 376. London and Toronto: J. M. Dent & Sons. 1930. Price 4s.

Every conscientious science master uses methods of his own for imparting knowledge to his pupils. There are several well-known methods for presenting the principles of chemistry to young students. At one time it was the practice to allow the pupils to find out almost everything from their own observations. Another method was to develop the subject historically and then there came the mode of stressing the applications of science to industry and to daily life.

Mr. Sutcliffe makes his primary aim the imparting of a systematic knowledge of chemistry as a science. He has, however, not overlooked the important "historical" and "every-day life" aspects which have been mentioned whenever needed or helpful.

The first part consists of 21 chapters, covering much of the ground of general inorganic chemistry as taught in secondary schools and is then followed by a few more revision lessons which extend and drive home the earlier work. The book is well illustrated and will doubtless commend itself to science masters generally.

Katalytische Reaktionen in der Organisch-Chemischen Industrie, Part I., by DR. HORST BRUCKNER. Pp. viii + 168, Dresden and Leipzig: Theodor Steinkopff, 1930. *Price 14 marks 50 pf.*

The significance of the "speeding-up" of chemical reactions is nowhere more apparent than in the manufacture of organic compounds. The present *Monograph* (Vol. XXII. in Professor Rassow's *Technische Fortschrittsberichte*) deals with the phenomenon of catalysis; the preparation of catalysts; the stabilisation of organic substances towards oxidation by means of "negative catalysts"; and catalytic oxidation, reduction and dehydration.

There is now a very wide range of catalysts available for the industrial chemist although it is safe to say that few have found a wide or full use. A score of metals are referred to in Dr. Bruckner's volume in addition to activated carbon, silica and certain metallic oxides.

Attention is directed to those substances known to all as poisons on catalysts and the mode of their removal is given.

A comprehensive list of patents of all countries is appended and although no error of fact has been detected one or two typographical mistakes have been observed.

It is surprising how many substances can be made more cheaply and efficiently by the use of well-known but little utilised catalysts and the publication of this work should be of service in arousing an interest in what promises to be a fruitful field for improvement in manufacturing processes.

A First Year Practical Chemistry. By Dennis Brook Briggs, M.A., F.I.C. Pp. 78. London & Toronto: J. M. Dent & Sons, 1930. Price 1s. 4d.

In this book Practical Chemistry is introduced to the young student by a study of solution and crystallisation. The distinction between elements, mixtures and compounds are next considered, and then follows a series of experiments on the air. This leads up to the isolation of oxygen, after which comes several investigations on the constitution of water.

Experiments illustrating the nature of acids, bases and salts and also marble complete this little volume which is replete with many those little details which are so often re-[illegible] as superfluous in textbooks.

[illegible]tself.

PUBLICATIONS RECEIVED.

U. S. GEOLOGICAL SURVEY.

The Helderberg Group of Parts of West Virginia, and Virginia. By Frank McKim Swartz. (Professional Paper 158-C.). Price 20 cents.

Petrography of the Pioche District, Lincoln County, Nevada. By Joseph L. Gillson. (Professional Paper 158-D.). Price 10 cents.

The Varves and Climate of the Green River Epoch. By Wilmot H. Bradley. (Professional Paper 158-E.). Price 10 cents.

Contact Metamorphism of the Rocks in the Pend Oreille District, Northern Idaha. By Joseph L. Gillson. (Professional Paper 158-F.). Price 10 cents.

Early Pleistocene Glaciation in Ihaho. By Clyde P. Ross. (Professional Paper 158-G.) Price 10 cents.

The Flora of the Frontier Formation. By C. W. Berry. (Professional Paper 158-H.). Price 5 cents.

The Mohawk Desert Region, California. By David G. Thompson. (Water Supply Paper 578). Price $2.00.

Geology and Ground Water Resources of North Dakota. By Howard E. Simpson. (Water Supply Paper 598). Price 50 cents.

Surface Water Supply of the United States, 1925. Part II., South Atlantic Slope and Eastern Gulf of Mexico Basin. N. C. Grover, Chief Hydraulic Engineer. (Water Supply Paper 602). Price 15 cents.

Surface Water Supply of the United States, 1925. Part III., Ohio River Basin. N. C. Grover, Chief Hydraulic Engineer. (Water Supply Paper 603). Price 40 cents.

Surface Water Supply of the United States, 1925. Part IV., St. Lawrence River Basin. N. C. Grover, Chief Hydraulic Engineer. (Water Supply Paper 604). Price 25 cents.

Forthcoming Events.

FORTHCOMING HEALTH CONFERENCE IN ATHENS.

The Commercial Secretary to His Majesty's Legation, Athens, reports that he has been informed by the Minister of Hygiene

that following upon the first Panhellenic Health Conference which is to be held in Athens in April next, the Greek Medical Association propose to arrange an exhibition of objects in connection with Hygiene in general.

At an interview which the Commercial Secretary had with Dr. Vlatianos, President of the Organising Committee, it was stated that the Government had promised to grant a subsidy to the Committee and that the Exhibition would be held in the Zappeion Building between the 1st May and 31st July. Dr. Vlatianos also stated that all exhibits would be free of customs duty and should reach Athens before the 31st March, but exhibits should not be shipped to Greece prior to the issue of a further announcement by the Organising Committee.

The exhibition is to be part of an active movement in Greece to increase and equip health centres in various parts of the country, to improve the sanitation of cities and to develop the new School of Hygiene at Athens on the lines recommended by the League of Nations Commission. It may therefore have an appeal to British firms from a commercial point of view, and in this connection a copy of the League of Nations Report on "Collaboration with the Greek Government in the Sanitary reorganisation of Greece," giving the recommendations regarding hospitals, malaria prevention, tuberculosis prevention, quarantine serviee, etc., is available for inspection at the Department of Trade, 35, Old Queen Street, London, S.W.1.

British fims interested should communicate with Dr. Vlatianos, President of the Organising Committee, Panhellenic Health Conference, Odos Kriezotou No. 1, Athens.

ROYAL INSTITUTION.

Friday, March 14, at 9 p.m.—"New Light on Vision." Prof. G. Elliott Smith, F.R.S.,

Saturday, March 15, at 3 p.m.—"Atomic Nuclei and their Structure." Sir Ernest Rutherford, F.R.S.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

The sixth meeting of the session will be held at the Milton Hall, Deansgate, Manchester, on Friday, March 14th, 1930, at 7.30 p.m. "A Members' Evening."

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

4,632.—Brating K.—Direct obtention of acetic acid from mixture of acetyl cellulose and acetic acid. February 11.

4,669.—Hurtley, W. R. H. & Imperial Chemical Industries, Ltd.—Synthetic production of lactic acid. February 12.

4,642.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of azo-dyestuffs. February 11.

4,926.—I. G. Farbenindustrie Akt.-Ges.—Manufactnre of vat dyestuffs. February 13.

Specifications Published.

324,966.—Carpmael, A. (I. G. Farbenindustrie Akt.-Ges.) — Manufacture of acid dyestuffs of the triphenylmethane series.

304,787.—I. G. Farbenindustrie Akt.-Ges.—Printing with vat-dyestuffs.

305,594.—I. G. Farbenindustrie Akt.-Ges.—Separating formic acid from acetic acid.

325,151.—Boots Pure Drug Co., Ltd., & Pyman, F. L.—Production of ad-diamino-B-ketobutane dihydrochloride and 2-thiol-4 (5)-B-aminoethylglyoxaline.

325,152.—Johnson, J. Y. (Farbenindustrie Akt.-Ges.).—Manufacture and production of ethylene from acetylene.

Abstract Published.

323,213.—Viscose.—Freukel, L., 15, Ploschad Borby, Moscow.

Small quantities of nitrous acid, preferably in the form of salts such as sodium nitrite, are added to viscose during its manufacture. The quantities added are preferably below 1 per cent. by weight, for example 0,3-0.4 per cent. The nitrite remains unchanged during the ripening of the viscose but exerts an oxidation effect during spinning and prevents the liberation of noxious gases, for example hydrogen sulphide, carbon disulphide, and sulphur dioxide.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ADALAC.

508,754.—All goods in class 1 which includes chemical substances used for manufactures, photography, or philosophical research and anti-corrosives. — Glazebrooks, Ltd. Tyseley Paint and Varnish Works, James Road, Tyseley, Birmingham. February 5.

PREVENTOL.

509,239.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives.—I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28, Frankfort-on-Main, Germany. February 12. (Associated.)

INVADINE.

509,398.—Chemical substances in class 1 for use as emulsifying agents and solvents, and for facilitating the wetting of fibrous materials, such as textile fibres and fabrics. — Society of Chemical Industry in Basle, 141 to 227, Klybeckstrasse, Basle, Switzerland. February 12.

CERESAN.

508,472.—A dressing for seeds, being a *chemical substance for horticultural* purposes.—Bayer Products, Ltd., *31 to 34, Basinghall Street, London,* E.C.2. February 19th.

ELASTO.

509,700.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—The Firm trading as The New Era Treatment Co., Cecil House, Holgorn Viaduct, London, E.C.1. February 19th. (Associated).

PESDETHA.

507,246.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—The Farinol Company, Ltd., "Farinol House." Ashburton Road, Trafford Park, Manchester. February 19.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book *appeal to the general scientific public.* It is also intended for use in Schools, where the *History of Science occupies a place in the* curriculum.

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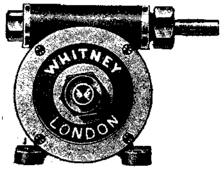

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NOTICE TO AUTHORS AND CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

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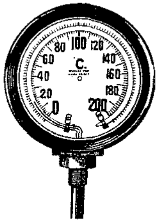

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NOTE ON THE SPECTROSCOPIC IDENTIFICATION OF EKA-CÆSIUM.

By F. H. LORING.

Continuing the spectroscopic search for eka-cæsium* — see sixth paragraph from end — the next line of investigation is to consider the spectral lines of the known alkali elements, Li, Na, K, Rb, and Cs, with the object of ascertaining the principal series lines of the highest member of the group, eka-cæsium, by a method of extrapolation. Having done this the lines so found can be compared with known lines appearing in the spectra of different elements, but particularly those of the higher member of Group I.

A. Fowler gives in his REPORT ON SERIES IN LINE SPECTRA (1922, or reprint 1927) the folllowing formulæ for calculating the principal lines of all the known alkali elements. Placing these equations in the order of the elements, beginning at lithium, it will be seen that three changeable constants are involved and one common constant, m being a number of the series 1, 2, 3, 4, 5, etc. ν is the vacuum wave-number.

TABLE II.

Probability number.		Wave-series numbers.		Atomic number and element.
3	×	$1 \cdot 1^2$ =	2 =	He
7	×	$2 \cdot 2^2$ =	10 =	Ne
9	×	$3 \cdot 3^2$ =	18 =	Ar
13	×	$4 \cdot 4^2$ =	36 =	Kr
21	×	$3 \cdot 3^2$ =	54 =	Xe
45	×	$2 \cdot 2^2$ =	86 =	Rn, Tn, An (isotopes)
119	×	$1 \cdot 1^2$ =	118 =	Limiting No. (Bohr)

TABLE I.

(Li) $\nu = 43486.30 - 109678.3 / (m + 0.951125 + 0.007766/m)^2$

(Na) $\nu = 41449.00 - 109678.3 / (m + 1.148066 - 0.031200/m)^2$

(K) $\nu = 35005.88 - 109678.3 / (m + 1.296281 - 0.061661/m)^2$

(Rb) $\nu = 33689.10 - 109678.3 / (m + 1.365753 - 0.073450/m)^2$

(Cs) $\nu = 31404.60 - 109678.3 / (m + 1.449446 - 0.088246/m)^2$

(87) $\nu = 29013.00 - 109678.3 / (m + 1.687560 - 0.112500/m)^2$

The last equation is one obtained by extrapolation by the method of the present writer as follows:

In order to extrapolate by means of a curve-plot it is desirable to reduce the values so that they will plot as near to a straight line as possible. This involves some form of equation, but the best plan seems to be to make use of a set of numbers already associated with the elements as shown by the following table (II).

These initial numbers, 3, 7, 9, 13, etc., may be regarded as probability constants or probability series numbers, as their application is general, since quite a number of physical values can be calculated by their use in connection with series-numbers (see for example, Loring, *Chemical News*, 1928, *136*, 225-229; *137*, 34-37).

Taking the constants of Table I and grouping them, and making use of the so-called probability numbers above, gives values that may be plotted as shown by Fig. 1, the plotted values being in heavy-face type in the following tables. As an inset in Fig. 1, a calculation of one of the lines is given for the benefit of those readers not familiar with the working details.

TABLE III.

			Diff.
Li	= 43486.30 =	$144.9 \times 10^2 \times 3$	−16.3
Na	= 41449.00 =	$592.1 \times 10 \times 7$	− 2.0
K	= 35005.88 =	**388.9** × 10 × 9	− 4.88
Rb	= 33689.10 =	**259.0** × 10 × 13	−19.1
Cs	= 31404.60 =	**149.5** × 10 × 21	− 9.6
87	= 29013.00 =	**64.3**47 × 10 × 45	—

TABLE IV.

			Diff.
Li	= 0.95112500 =	$317 \times 10^{-3} \times 3$	−0.000125
Na	= 1.1480660 =	$164 \times 10^{-3} \times 7$	−0.000066
K	= 1.2962810 =	**144** × 10^{-3} × 9	−0.000281
Rb	= 1.3657530 =	**105** × 10^{-3} × 13	−0.000758
Cs	= 1.449446 =	**69** × 10^{-3} × 21	−0.000446
87	= 1.687500 =	**37.5** × 10^{-3} × 45	

* See in this connection K. T. Bainbridge's paper in the *Physical Review*, 1929, *34*, 752; abstracted in *Chemical News*, 1929, *139*, 261.

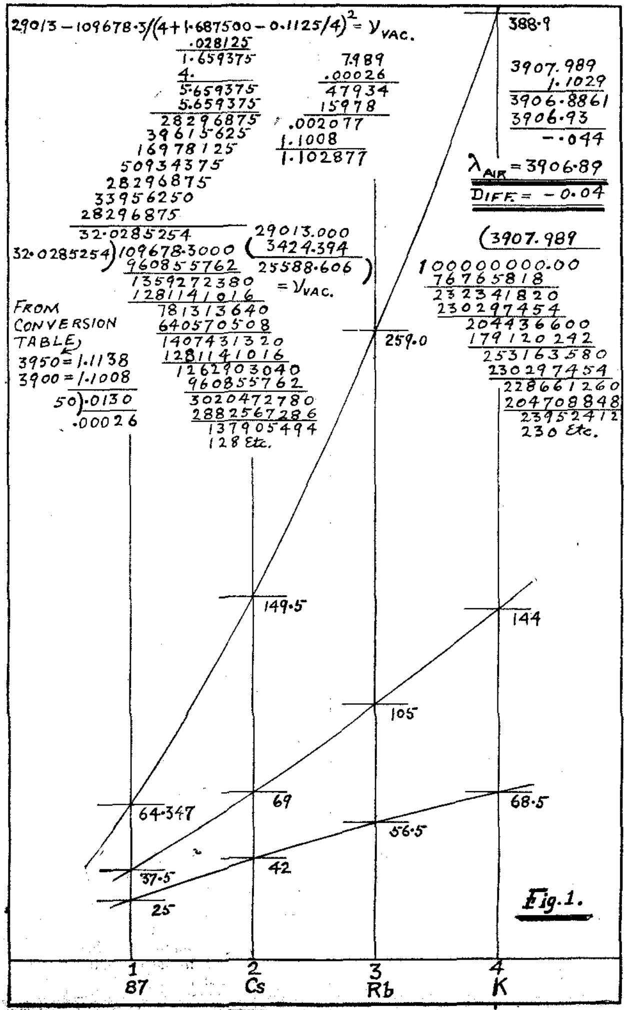
29013 − 109678·3/(4+1·687500−0·1125/4)² = ν VAC.
·028125
1·659375
4·
5·659375
5·659375
28296875
39615625
16978125
50934375
28296875
33956250
28296875
32·0285254
32·0285254)109678·3000
9608557762
1359272380
1281141016
78131364o
640570508
140743132o
128114l016
126290304o
960855762
3020472780
2882567286
137905494
128 Etc.
7989
·00026
47934
15978
·002077
1.1008
1·102877
29013.000
3424.394
25588·606
= ν VAC.
FROM CONVERSION TABLE
3950 = 1.1138
3900 = 1.1008
50)·0130
·00026
388·9
3907.989
1.1029
3906·8861
3906·93
−·044
λ AIR = 3906·89
DIFF. = −0·04
(3907.989
100000000.00
76765818
232341820
230297454
204436600
179120242
253163580
230297454
228661260
204708848
23952412
230 Etc.
259·0
149·5
144
105
64·347
69
68·5
56·5
37·5
42
25
1
87
2
Cs
3
Rb
4
K

Fig. 1.

TABLE V.

		Diff.
Li	$=0.007766=25.9\times10^{-4}\times3$	+0.000004
Na	$=0.031200=44.6\times10^{-4}\times7$	+0.000020
K	$=0.061661=\mathbf{68.5}\times10^{-4}\times9$	−0.000011
Rb	$=0.073450=\mathbf{56.5}\times10^{-4}\times13$	0.000000
Cs	$=0.088246=\mathbf{42.0}\times10^{-4}\times21$	0.000046
87	$=0.112500=\mathbf{25.0}\times10^{-4}\times45$	———

Using the equation values as obtained from the above scheme of extrapolation the first seven principal lines come out as follows (shown in heavy-faced type). The surrounding wave-length values, listed on the left-hand side, are those as obtained from cæsium and taken from Kayser and Konen's HANDBUCH DER SPECTROSCOPIE (1924), pp. 318 to 326.

Line in K. & K.			87 principal line.	Diff.
8053.35	(2v)	Meissner		
8018.9	(20)	Randall		
8016.9	(5r)	Meggers		**−1.02**
8016.28	(8r)	Meissner	**8015.88**	**−0.40**
8016.2	(5r)	Meggers (see K. & K., 318)		
7990.68	(2v)	Meissner		
4851.58	(1)	Sommer		
4830.16	(6)	Sommer	**4830.69**	**+0.53**
4829.3	(12)	Dunoyer		
4804.45	(0)	Sommer		
4187.58	(1)	Sommer		
4174.2	(1)	Dunoyer		**+1.63**
4173.53	(3)	Sommer	**4175.83**	**+2.30**
4164.2	(1)	Dunoyer		
4163.24	(3)	Sommer		
4158.61	(4)	Sommer		
3910.31	(0)	Sommer		
3907.3	(2)	Dunoyer		
3906.93	(4)	Sommer	**3906.89**	**−0.04**
3905.4	(2)	Dunoyer		
3904.81	(3)	Sommer		
3900.09	(0)	Sommer		
3785.8	(10)	Dunoyer		
3785.42	(5)	Sommer		
3764.79	(0)	Sommer	**3766.26**	**+1.47**
3751.8	(5)	Dunoyer	3765.3(0)*	**+0.96**
3751.40	(3)	Sommer		
3734.8	(10)	Dunoyer		
3734.4	(4)	Sommer		
3711.5	(2)	Dunoyer		
3710.77	(2)	Sommer		
3700.3	(10)	Dunoyer		
3699.48	(5)	Sommer		
3682.46	(0)	Sommer	**3682.46**	**0.00**
3681.0	(8)	Dunoyer		
3680.45	(2)	Sommer		
3680.10	(2)	Sommer		
3641.83	(4)	Sommer		
3631.9	(4)	Dunoyer		
3630.71	(1)	Sommer		
3630.62	(1)	Sommer	**3628.15**	**−2.47**
3625.5	(2)	Dunoyer	3627.2(0.5)*	**+0.95**
3624.44	(0)	Sommer		
3623.8	(2)	Dunoyer		
3622.69	(2)	Sommer		
3619.5	(6)	Dunoyer		

It is to be noted that the differences above are on the whole as good as, if not better than, is the case with the calculated lines of some of the other alkali metals.

The constant 109678.3 is used as the other constants given by Fowler (*loc. cit.*) would have to be altered if this one is changed, for the extrapolation is based upon the constants given in the report.

It is possible that some line overlapping may exist which makes it difficult to be sure that in every case pure lines are matched. None of the properly matched lines for identification appear in the series lines tabulated by Fowler in his report.

While the line-strengths of the matched lines are about in the order of intensity to be expected, there is no guarantee in this case.

It will be seen that the existence of eka-cæsium as an impurity in cæsium is apparently made evident by the line-agreements. This helps to support the scanty X-ray identification already published in these pages (see Loring and Druce, *Chemical News*, 1925, *131*, 289, 305, 337; Loring, *ibid*, 1925, *131*, 338, 371; 1926, *132*, 101).

An appropriate name for this element would be Alkalinium, Ak, it being the most alkaline element of the group, that is to say, the most electropositive.

That such an element should exist and not be radioactive, at least in the meaning of the term as indicated by the radioactive-series elements, is not surprising for there is the example of bismuth which is more or less surrounded by short-lived products and yet it has an odd atomic number and its atomic weight appears also to be odd. Alkalinium would have a low boiling point, below that of cæsium, and it might be widely disseminated in nature, and owing to its rarity easily escape detection by the ordinary methods.

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* From TABLES ANNUELLES (1925) p. 421 —L. Bruninghaus. The Line-strength supports the latter value better than

COMMENT.

Methods of extrapolation are not generally regarded with favour and it is probable that the constants employed here for this purpose are not the exact values notwithstanding the agreements obtained. The first line is close to a fundamental line of cæsinm as given in Fowler's report, but there appear to be several lines involved which are very nearly the same wavelength. This is satisfactory, and it may be that there are complexities of this kind that the present writer has not taken into account. For this reason no importance should be attached to the seeming line-intensity regularity.

If the first line is identified with the one higher up the difference comes ont at −1.02. Exact agreements mean nothing; in fact, it is to be expected that deviations would be in order considering the difficulty of determining the constants with absolute precision. The attempt, however, seems worth recording.

It is important to note that according to the equation here given the first line falls in a region of very few available lines and this narrows the choice, but the faint lines in this region may be obscured by the glare from the strong lines of cæsium; and, moreover, bands develop in the very long-wave length region. Therefore, the $m=1$ series line should not be considered.

ADDENDUM.—From Bainbridge's paper and references therein (*loc. cit.*, p. 754) it would appear impossible to detect spectroscopically very small amounts of eka-cæsium in cæsium. So much depends upon technique in this case the present writer is not able to venture an opinion; but the ionisation potentials of the alkali metals run: Li=5.37, Na=5.11, K=4.32, Rb=4.16, Cs= 3.89, making eka-cæsium about 3.75. This would be lower than any other element in the periodic table; and should perhaps afford a means of spectroscopic identification. On this account it seems important to get out an exact equation for calculating the principal series lines. The present method can no doubt be improved upon; such, for example, as shaping the curves at their lower extremity to meet at a common zero. In this case 64.347 stands, 37.5 becomes 34, and 25 becomes 22.5. 64.347 can be adjusted in the decimal region to fit any selected line.

ANNUAL REPORT ON THE FERMENTATION INDUSTRIES, 1929.

(*Prepared for the Society of Chemical Industry and the Institute of Brewing.*)

By H. LLOYD HIND, B.Sc., F.I.C., AND F. E. DAY, B.Sc., F.I.C.

ABSTRACT.

In their Report for 1929 the authors have considered in detail several fields of research in which the results of important work have been published, and have summarised the state of knowledge. For this they have drawn freely on the publications of previous years, and the Report is of value not only as a summary and discussion of recent work but also as an indication of some details which require further investigation.

The significance of the nitrogen content of the cereals used as the raw materials of the fermentation industries has come to be regarded almost as an axiom. Its importance in brewing has been recognised more or less clearly ever since scientific methods were first applied. This importance arises from a number of causes: the nitrogen compound acts as diluents of the carbohydrates of the grain and hence rednce the available extract; they also serve as essential aliments for the micro-organisms concerned and govern, to some extent, the enzymic activity; further, high nitrogen in barley leads to malting loss.

For some years past barley breeding and selection has aimed to produce low nitrogen content, so far as the chemical constitution of the grain is concerned, in the belief that high nitrogen is associated with low extract in the malt and instability in the resulting beer. It is difficult at present to suggest any more useful criterion of barley quality than that afforded by its total nitrogen content, but many now hold that too much weight has been placed on the total quantity of nitrogen and that other factors of a qualitative nature must be taken into consideration, and may be of even greater importance.

Quality in beer depends on several factors which may, in the main, be considered to fall in two groups. Flavour, colour, and aroma, thongh influenced by the barley, are mainly determined by conditions of malting, hopping, and fermentation. The majority of recent investigators agree that head retention, palate fulness, and both colloidal and biological stability are in varying degree largely dependent on nitrogenous substances, as yet not clearly defined but derived from original protein constituents of the barley. Herein lies the real connection

between barley quality and its value to the brewer, and in so far as barley will give satisfactory beed it should be judged to be of good quality. Its appearance and total nitrogen content are generally held to give the safest available indication of quality, but as indices they can only be of real value in so far as they can be shown to be related to this final standard.

The actual barley proteins are now under investigation by L. R. Bishop at Rothamsted as part of the Institute of Brewing Research Scheme. He has separated the proteins into fractions (*a*) soluble in cold 5 per cent. solution of potassium sulphate, (*b*) soluble in 70 per cent. alcohol at 81°, and (*c*) insoluble residue. The last two components are hordein and glutelin respectively and evidence is put forward to show that the former and probably the latter are individual proteins which can be separated in a fairly pure state. The salt-soluble fraction can be separated into albumin, globulin, proteose, and simpler protein degradation products. Bishop's results indicate a totally unexpected regularity in the proportions of the barley proteins. Reference was made in last year's Report to the first part of this work and to the indication that for each variety of barley the total nitrogen percentage is an accurate measure, though not necessarily in direct proportion, of the different constituent proteins.

Hence it appears that within one variety the amounts of the separate proteins are defined by the total nitrogen, and that soil, season, and manuring affect the proportions of the proteins only by their effect on the total nitrogen. Different varieties appear to show variations in these proportions and the possibility is suggested of breeding barleys to yield these proteins in the most advantageous proportions, when these have been determined.

Preliminary experiments made by Bishop suggest that variations in the amount of water supplied to the grain do not affect the extent of breakdown of the proteins, and in an experiment on the effect of different flooring temperatures H. Sadler, employing Bishop's analytical methods, found no evidence of alteration in the protein ratio. The relation between the nitrogeneous constituents of a barley and the corresponding malt would thus appear to be fairly stable, and Bishop suggests that this may be due to the altered conditions affecting similarly both the breakdown in the endosperm and re-synthesis in the embryo. This equilibrium does, however, appear to be altered in the experiments of F. F. Nord and J. Weichherz, in which it was found that the formol nitrogen was increased by treatment of the germinating grain with traces of acetylene or ethylene. On the other hand it cannot be regarded as established that under all conditions the modification of protein proceeds *pari passu* with that of the other constituents of the endosperm and with rootlet and acrospore growth. H. Lüers found a variation in the proportions of soluble and insoluble nitrogen when he malted at different temperatures for different periods to obtain equal modification.

F. A. Csonka and D. B. Jones have made comparisons of the glutelins of rye and barley obtained by extraction with 50 per cent. alcohol containing 0.2 per cent. of sodium hydroxide and purification by precipitation at p_H 6.8 obtained by addition of hydrochloric acid. The rye extract yielded a single glutelin only, whilst that of barley yielded an α-glutelin which was precipitated by ammonium sulphate at concentrations of 1—3 per cent., and a β-glutelin precipitating at 18 per cent. saturation. The α-glutelins of both these cereals appear to resemble that of wheat. As Bishop's investigations indicate a definite relation between the glutelin and the total protein of a given race of barley, it may be of interest, *if this fractionation of glutelin is confirmed*, to consider the relative amounts of the two fractions in connection with the quality and properties of barley.

Work of the type now being undertaken by Bishop must be carried right through the brewing process, for all parts of that process are inter-related and the composition of the barley proteins must, to a great extent, determine that of the beer proteins. A considerable amount of information has been accumulated in regard to the former and an insight has been obtained into the changes which occur during malting. How far these changes can be modified by altering the malting conditions appears to be the next problem awaiting solution, as under the conditions of mashing employed in the majority of English breweries there is little opportunity of varying the protein degradation. The action of the enzymes concerned is much restricted at the temperatures employed in the mash tun, and the brewer is largely dependent on the maltster for the production of the desirable nitrogenous wort constituents.

A wide diversity of opinion has been expressed in regard to the effect of the tannin of hops in brewing and in particular in reference to the removal of proteins during

boiling. H. Bilgram has approached the question in a new way and by making experimental brews with and without the tannin has endeavoured to decide to what extent it is operative in this direction and how it affects the flavour of beer. He found it very difficult to come to any definite conclusions on the precipitating effect of tannin, but analyses of worts boiled with and without tannin gave indications that the more complex proteins are not so well precipitated in its absence. The tannins form two types of compounds with the complex proteins, the one irreversible and known as phlobaphen-protein compounds, the other comprising the protein-tannins which are redissolved at high temperatures and may be reprecipitated when the temperature is very low during fermentation or under the influence of changes of acidity. These haze-forming substances are referred to later.

(To be continued.)

THE CHEMIST AND COMMERCE.

The Institute of Chemistry's First S. M. Gluckstein Memorial Lecture, December 13, 1929.

By Leslie H. Lampitt, D.Sc., F.I.C.

(Continued from page 169.)

Dr. H. J. Bush said that they must give credit to the German plant makers for the ideas and practices they had developed, but that did not make it necessary to import foreign plant into this country, because he believed that we could produce chemical plant as good as that of any Continental rivals as regards workmanship and design. Perhaps in the manner in which our wares were presented to potential purchasers, Germany was a little ahead of us. Their specifications were extremely elaborate and possibly might give a purchaser the idea that he was buying a Rolls-Royce when he was really getting a Ford. Another point he wished to bring out was that perhaps we were more inclined to urge the purchaser to go in for a Rolls-Royce wheu a Ford would really do the job. That was a national characteristic, a national bias in favour of the highest possible quality, but it should be remembered also that in this country we he had to comply with very stringent Goverment Regulations from which the foreigner was exempt, even on plant imported into Great Britain, and this made the British manufacturer more careful of the quality of his product. Given an equal chance, they had no reason at all to fear comparison with their Continental rivals, but he was afraid that for various reasons the British maker did not always have a level start.

Mr. W. J. Coles attributed the misunderstandings in regard to delivery to modifications of the orginal specifications often made by the purchaser; all those variations delayed delivery and made the final result a little more uncertain.

Mr. W. B. Pickering (Hadfields, Ltd.) prefaced his remarks by thanking the Chairman for his invitation and said how interested he had been in the opening remarks of Mr. Ballantyne as well as the subsequent discussion, most of which had been of a helpful and constructive character.

We were all greatly interested in the question that had been so ably dealt with by Mr. Ballantyne, but had he not himself given one very important reason for not ordering foreign chemical plant? He thought he had, for where confidence was an important factor the home manufacturer could be relied and depended upon, which was not the case with our foreign competitors.

To-day it seemed to be a fashion in the press to disparage us, our abilities and our manufacturers, and not only abroad, but unfortunately at home, our customers were beginning to take us at the press valuation.

The discussion was brought to a close by a very frank and vigorous summing up by the Chairman, Mr. J. Arthur Reavell, in which he warmly asserted the claims of British plant makers. He accepted the post of chairman of that Association, he said, because he thought that it deserved support and that British makers should co-operate together in their common interests. When he handed the chair over to Dr. Bush, he would be leaving the Association increased in membership and increased in influence because they pulled together. They would agree that the discussion that eveuing had been thoroughly worth while. It had done something to destroy the persistent worship of the foreigner.

To begin with, he would like to ask why foreigners could get so much better terms of payment from chemical manufacturers than British makers could. The

usual conditions of plant manufacturers abroad were 30 or 50 *per cent.* with the order and the balance against shipment. In this country the terms for contracts of any size were 80 *per cent.* against delivery, 10 *per cent.* on erection, and the balance on starting up. He himself had had to advise on the alterations and adjustment of installations which had been a complete failure, and which had been built abroad. The makers had received full payment and nothing could be done.

GENERAL NOTES.

STANDARD GAS PRACTICE.

Five times as many persons die in a year from falling downstairs as are said to be accidentally poisoned by gas.

This remarkable statement, showing the extraordinarily small death rate from accidental gas poisoning during the last ten years, is made in the report (published last week) on "Standard Practice of the South Metropolitan Gas Company" adopted with a view to securing the efficient, economic, hygienic and safe distribution of gas.

The death rate has been calculated as approximately one per annum per 92,000 premises supplied with gas, or say one death per annum for every 350,000 to 400,000 persons who have the benefit of the use of gas in premises supplied with it.

From very early days, it appears, the South Metropolitan Gas Company has laid turned-and-bored cast-iron mains, and this policy has been justified by the fact that such mains which have been in the ground for more than fifty years, appear on examination still to be good for an indefinite period. The tensile breaking strength for these cast-iron pipes has, according to the company's specifications, to be not less than twelve tons per square inch. Very few gas consumers realise that their gas fittings are accurate to the ten-thousandth part of an inch, and are examined and tested by very delicate and intricate instruments.

The number of gas meters in use in the Company's area of supply is about 412,000 and approximately 73 per cent, are provided with pre-payment slot-meters.

BOARD OF TRADE ANNOUNCEMENT.

DYESTUFFS (IMPORT REGULATION) ACT, 1920
APPLICATIONS FOR LICENCES IN FEBRUARY, 1930.

The total number of applications received during the month was 746, of which 637 were from merchants or importers. To these should be added 18 cases outstanding on the 31st January, 1930, making a total for the month of 764. These were dealt with as follows :—

Granted—706 (of which 683 were dealt with within 7 days of receipt).

SULPHUR INDEPENDENCE FOR CANADA.

Canada may shortly become independent of Louisiana and Texas for supplies of sulphur required in the production of sulphur dioxide gas and sulphuric acid, if the new method of burning pyrite now being developed at the plant of the Canada Power and Paper Company at Three Rivers, P.Q., is the success it promises to be. This method will utilize the sulphur contained in the large quantities of pyrite which up till now have been discarded as a waste product from the flotation treatment of the base metal sulphide ores.

According to Mr. W. B. Timm, of the Mines Branch of the Dominion Department of Mines, the method is not only new but unique. Its basis is a new form of burner which has been developed by Mr. Horace Freeman, of Shawinigan Falls, P.Q. It is claimed that this new burner has practically solved the problem of producing from Pyrite a grade of gas suitable for use by pulp and paper manufacturers and in sulphuric acid plants.

Most of Canada's base-metal sulphide ores contain a high percentage of pyrite which has to be separated from them in producing a high-grade concentrate of the more valuable minerals. By making a selective float of the tailings a pyrite concentrate can be obtained containing 48 per cent. to 50 per cent. sulphur. It is in the commercial use of such a concentrate that Mr. Freeman hopes to show an additional profit to the mining company whose ores contain pyrite and a saving to the pulp company in the production of cheaper sulphur dioxide gas.

The chief feature of the new burner is its all-round efficiency. The difficulty hitherto encountered in the low combustibility of the pyrite fines has been entirely overcome.

The pyrite is conveyed by suction ,dried, and burnt in suspension as a powdered fuel. *The sulphur dioxide is, upon leaving the* furnace, treated and washed to free it from all dust and sulphur trioxide before entering the limestone towers for the production of digestor liquors. By sintering the iron oxide resulting from the pyrite burning a marketable iron product is obtained, which can be utilised in the iron blast furnace.

MANCHESTER SPEAKING

LARGEST TELEPHONE EXCHANGE IN EUROPE.

Telephone House, Manchester's new telephone exchange, is progressing apace. When complete with its three automatic exchanges and the auto-manual, it will be the largest telephone exchange in Europe, and will have claims to being even the largest in the world.

Actually, the building is not in Manchester at all, but in the adjoining borough of Salford. Rising on the one side 163 feet above the level of the River Irwell, and on the other, 128 feet above the street, it has nine storeys and five acres of floor-space, all of which will be needed for the plant and staff. Three main automatic exchanges will eventually be accommodated on the first three floors of the exchange.

At present chief attention is being concentrated on the auto-manual and toll switchboards, which will work in conjunction with three automatic exchanges to be opened in the suburbs early this year.

The automatic apparatus includes a full subscribers' unit of 10,000 lines, manual equipment for dealing with special fee calls and enquiries, and auto-manual equipment for handling traffic from manual exchanges.

QUEBRACHITOL.

A new procedure has recently been described by Levi (*Gaz. Chim. Ital.*, LIX, 8, 550) for separating quebrachitol from the serum of the latex of Hevea brasiliensis.

According to this method the proteins are first precipitated by tannic acid, evaporation then being carried on until all the water is eliminated, and the residue dissolved in an equal weight of glacial acetic acid. The quebrachitol crystallises from this solution in a practically pure state.

Three new esters of quebrachitol are described. Quebrachitol penta-isovalerate $(C_4H_9COO)_5C_6H_6OCH_3$, which is prepared by refluxing the quebrachitol with isovaleric chloride. This ester is liquid at ordinary temperatures.

Quebrachitol pentalaurate $(C_{11}H_{23}COO)_5C_6H_6OCH_3$, which is prepared by heating in vacuo at 120-160° C. a mixture of quebrachitol and lauryl chloride, the product of the reaction being crystallised from alcohol, m.pt. 82°C.

The quebrachitol pentapalmitate $(C_{15}H_{31}COO)_5C_6H_6OCH_3$, which is prepared by heating in vacuo to 120-160°C. a mixture of quebrachitol and palmityl chloride. This product is crystallised from alcohol, m.pt. 58°C.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, March 6.

The following papers were read :—

...*Structure in very Permeable Collodion Gel Films and its Significance in Filtration Problems.* By W. J. ELFORD. Communicated by J. F. Barnard, F.R.S.

Optical studies of permeable collodion films bave revealed the existence of two very definite types of structure : (i) microgel structure of microscopic order, (ii) ultragel structure of ultramicroscopic order. The general nature of these structures has been established for several different nitrocottons and the conditions determining them investigated.

Gelation in this particular instance is a process of phase transition resulting from the coagulating influence of desolvation. The precise nature and stability of the gel is a function of the specific characters of the nitrocellulose and solvent, and the variation in free surface forces around the dispersed phase particles with differing degrees of molecular complexity of the system.

The bearing of these observations upon ultra-filtration has been discussed. A complete explanation of the general behaviour of ultra-filter membranes is afforded and a sound basis established for the interpretation of filtration results.

Vertical Electric Currents below Thunderstorms and Showers. By T. W. WORMELL. Communicated by C. T. R. Wilson, F.R.S.

This paper describes observations on the discharge of electricity beneath thunderstorms and showers from a raised metal point, 12.3 metres above the ground. It is found that in the course of a year the net effect of the point is to discharge about +0.13 coulombs into the atmosphere. Records of the variation of the current, as individual shower clouds passed overhead, strongly suggest that the majority of the clouds which have been observed were of positive polarity, *i.e.*, mean height of positive charge in cloud was greater than mean height of negative charge.

An attempt has also been made to use the results of these observations to estimate the contribution of point-discharge currents to total interchange of electricity between earth and atmosphere. It seems probable that, in the locality in question, the effective gain of negative electric charge by the earth through the mechanisms of point-discharge currents and lightning discharges is at least as large as the sum of the positive

charges brought down by the fine-weather current and by rain.

It seems to be fairly certain that effective upward current caused by point-discharges and lightning is greater than current carried down by rain alone, and, therefore, that there must be vertical current of positive charge from earth through cumulo-nimbus cloud to upper atmosphere. The observations are thus in agreement with C. T. R. Wilson's hypothesis that downward current in fine-weather regions from upper atmosphere. The observations are thus in agreement with C. T. R. Wilson's hypothesis that downward current in fine-weather regions from upper layers of atmosphere to ground is, on the average, balanced by upward current in regions of cumulo-nimbus from earth through cloud to upper atmosphere.

The following papers were read in title only :—

Antimony Analogues of the Carbazole Series. By G. T. MORGAN, F.R.S., AND G. R. DAVIES.

The chemistry of organic derivatives of antimony is in a much more fragmentary condition than that of the organic arsenicals, and in the present communication another gap is filled by a description of the antimonial analogues I of the carbazole series II. The following structural formulæ represent this analogy, where X is an alkyl or aryl radical.

The starting point in this investigation is commercially available diphenyl, from which *o*-aminodiphenyl or *o*-xenylamine is readily obtained. This base is converted into *diphenyl-o-diazonium antimony tetrachloride* $C_6H_5.C_6H_4.N_2.SbCl_4$, which by the Schmidt reaction is transformed into *xenyl-o-stibine* dichloride $C_6H_5.C_6H_4\ SbCl_2$, which by loss of hydrogen chloride undergoes ring closure with formation of *xenylene-2 : 2′-stibine chloride.* Double decomposition with sodium iodide leads to *xenylene2 : 2′-stibine iodide*, which on treatment with magnesium methiodide furnishes *xenylene-2 : 2′-methylstibine*, the antimonial analogue of *N*-methylcarbazole.

...*The Kinetics of the Oxidation of Gaseous Benzene.* By R. FORT AND C. N. HINSHELWOOD, F.R.S.

The oxidation of gaseous benzene is a predomiuantly homogeneous reaction. The first products are formed without pressure increase and then oxidised further, by a mechanism rather closely resembling the oxidation of ethylene or acetylene, probably to glyoxal, formaldehyde and formic acid. The final products are steam and carbon monoxide with a smaller proportion of carbon dioxide.

The rate of reaction varies according to a higher power of the benzene concentration; and a high ratio of benzene to oxygen favours rapid oxidation. Over a certain range, increase in the oxygen concentration may retard the reaction ,though in another range the rate increases with the oxygen concentration.

It appears probable that comparatively short reaction chains are propagated, the variation in the length of which gives rise to the abnormal influence of temperature and pressure on the velocity. From the much greater sensitiveness of the rate to benzene condentration than to oxygen concentration ,it is concluded that chains are propagated more readily when the initial oxygenated product encounters anothers molecule of hydrocarbon than when oxidised further by oxygen. These results are analogous to those found on oxidation of ethyleue, and have suggested investigation of the oxidation of a substance, such as methyl alcohol, already containing oxygen in its molecule.

The Conductivity of Thiocyanates in Methyl Alcohol. By A. UNMACK, D. M. MURRAY-RUST, AND SIR HAROLD HARTLEY, F.R.S.

The electrical conductivity of solutions in methyl alcohol of the thiocyanates of the alkali metals and of some divalent metals has been measured at 25° C. The univalent thiocyanates obey the square-root relationship $\Lambda_c = \Lambda_0 - x\sqrt{c}$, and a comparison of the values of x with those calculated from Onsager's equation shows that the degree of association is slight, but increases with the atomic number of the metal. The mobilities of the alkali metals found by Frazer and Hartley are used to calculate the mobility of the thiocyanate ion, which is found to be 60.9.

The divalent thiocyanates fall into two groups : those of barium, strontium, calcium and magnesium, which give Λ_c :c curves approximating to straight lines at high dilutions, aud zinc and cadmium thiocyanates which are weak electrolytes. Comparison of theoretical and experimental results for the former group shows that there is considerable association in each case, which becomes greater as the atomic number of the metal decreases.

The Polytopes with Regular-Prismatic Vertex Figures. By H. S. M. COXETER. Communicated by H. F. Baker, F.R.S.

The polytopes here called "uniform" are those most directly analogous to the Archimedean solids. Having all its vertices equivalent, such a polytope is determined by a (suitably defined) section near one vertex. This section is called the "vertex figure." All the uniform polytopes whose vertex figures are of a particularly simple kind (namely, generalised prisms with regular constituents) are obtained, and then further new polytopes whose vertex figures are these, and so on. This process terminates (except in trivial cases), and we are left with a family of polytopes, important as having a remarkable relation to algebraic geometry.

The groups of symmetries (*i.e.*, of congruent self-transformations) of these polytopes are investigated with a view to generation by *two* operations. In particular, groups isomorphic with the groups of automorphisms both of the bitangents of the general plane quartic curve and of the lines on the cubic surface, are reduced to this simplest type of generation.

The Elasticity of Pintsch Crystals of Tungsten. By S. J. WRIGHT. Communicated by Sir Thomas Stanton, F.R.S.

The torsional moduli of rigidity of six wires, of which five were single crystals of Tungsten of different orientations, while the remaining one consisted of three crystals, were determined by a dynamical method. No differences in modulus between the various wires could be detected. The range of different orientations considered was such that a variation in modulus of about half the maximum possible variations due to cubic symmetry should have been encountered. The order of accuracy of the determination was such that differences of one part in 400 would have been observed. The results indicated, therefore, that the variations in elastic properties of Tungsten crystals over the whole range of possible orientations would not exceed 1 part in 200. Since tests of different samples of a material generally show greater differences than this, on account of lack of homogeneity, it was concluded that Tungsten crystals are isotropic.

Determinations of the longitudinal Young's modulus were also made on two wires, and, on the assumption that the material was isotropic, all the elastic constants were calculated.

Study of Electrolytic Dissociation by the Raman Effect. I. RAMAKRISHNA RAO. Communicated by O. W. Richardson, F.R.S.

On taking the Raman Spectra with different concentrations of Nitric Acid, it is found that the Raman line at 4,566.8 A.U., which is found common to Nitric Acid and Nitrates and must therefore be due to the NO_3-ion, increases in intensity with increasing dilution of nitric acid. But the line at 4,620.3 A.U., which is present only in nitric acid, but not in nitrates, and which must therefore correspond to the undissociated HNO_3 molecule, diminishes rapidly in intensity with increasing dilution. This clearly indicates the phenomenon of the Dissociation of Nitric Acid. Intensity measurements show that the variation of the Degree of Dissociation found from this is similar to that found from conductivity measurements, but different in order of magnitude. The differences are explained.

Thursday, March 13.

A Theory of Tracheal Respiration in Insects. By V. B. WIGGLESWORTH. Communicated by Sir Walter Fletcher, F.R.S.

The theory provides for the increased demands for oxygen which arise locally in active tissues. If it be assumed that the terminal portions of the tracheal tubes are bounded by a semi-permeable membrane, then liquid will be drawn up the tubes by capilliarity until further progress is checked by osmotic pressure of the tissue fluids. During activity lactic acid will be produced, osmotic pressure will rise, liquid will be absorbed and air will extend down the tubes towards the active tissues.

The theory is supported by experiments on larva of mosquito. It is found (1) that in resting condition the terminal portions of the tracheoles are filled with liquid; (2) during asphyxiatiou the liquid is absorbed and the column of air extends rapidly towards the contracting muscles, more slowly and much later towards inactive tissues (and gills); (3) on re-admission of air the liquid rises slowly to its original level; (4) during asphyxiation excess of lactic acid is present in the tissue fluids; (5) hypertonic solutions of sodium chloride and potassium lactate, introduced into living larva, cause extension of air down tracheoles; (6) tissue fluids from an asphyxiated larva have a similar effect; (7) hyptonic fiuids (distilled water) are with out effect or cause a slight rise of the liquid in the tracheoles.

Some observations are recorded on the effects of certain poisonous gases and of oil or the tracheal system.

Studies in the Biochemistry of the Lower Fungi. By H. RAISTRICK (and others). Communicated by Sir Frederick Hopkins, F.R.S.

THE CHEMICAL SOCIETY.

Passivity of Metals. Part IV. The Influence of acids in passivity and corrosion. By U. R. EVANS.

Chromic acid has strong oxidising and base-solvent properties; it produces passivity when present alone, but stimulates corrosion if sulphuric acid also is present.

The ferric oxide film usually present on iron is rapidly destroyed by dilute sulphuric acid owing to the formation of the circuit iron—acid—oxide; the ferric oxide suffers cathodic reduction to ferrous oxide, which is rapidly dissolved by the acid. If the reduction is prevented by the presence of excess of chromic acid, or by anodic treatment of the specimen as a whole, the film can remain in contact with 0.1*M*-sulphuric acid for hours without change. This explains why iron can remain passive in acid solution during anodic treatment. The corrosive qualities of carbon dioxide have been exaggerated in the past, and probably the damage attributed to carbon dioxide has really been due to sulphur dioxide or hydrogen chloride. If water is allowed to condense in droplets on iron, some of the droplets develop rust, whilst others (which do not happen to rest on a weak point) remain clear; this is true whether carbon dioxide is present or absent, and the clear drops may be dried up in a stream of carbon dioxide without developing rust. Hydrochloric acid vapours quickly produce rusting. A solution of carbonic acid causes at first slight corrosion of the hydrogen evolution type, but the pH rapidly rises and the formation of hydrogen ceases; the ferrous hydrogen carbonate produced yields ferric hydrogen at the water-line, and this obstructs diffusion of oxygen and prevents attack of oxygen-absorption type. In effect, therefore, a solution of carbonic acid is not dangerously corrosive; but it must be remembered that the presence of excessive free carbonic acid in a hard natural water may prevent the deposition of calcium compounds which would otherwise bring the action to a standstill.

Crystalline α-Methylmannofuranoside (α-methylmannoside). Part I. By W. N. HAWORTH and C. R. PORTER.

The above compound has been synthesised by the following methods: mannose dicarbonate has been methylated by the agency of either diazomethane or Purdie's reagents, and has given rise to the crystalline α-methylmannofuranoside dicarbonate which, by elimination of the carbonate residues, was converted into α-methylmannoside. The physical properties are [compar]ed with those of the previously known α-methylmannopyranoside. This represents the synthesis of the first crystalline form of a γ-methylmannoside.

Part II. By W. N. HAWORTH, E. L. HIRST, AND J. I. WEBB.

The chemical behaviour of the above new variety of α-methylmannoside has been investigated, and a number of crystalline derivatives are described. A constitutional proof is adduced, and this indicates that the substance possesses a five-atom ring structure contrasting with the six-atom ring form of α-methylmannoside.

Influence of poles and polar linkings on the course pursued by elimination reactions. Part VII. A generalised form of the olefinic degradation of sulphones. By G. W. FENTON and C. K. INGOLD.

Part VIII. The methylenic and paraffinic degradations of sulphones. By C. K. INGOLD and J. A. JESSOP.

Part IX. Isolation of substance believed to contain a semi-polar double linking with participating carbon. By C. K. INGOLD and J. A. JESSOP.

INSTITUTE OF CHEMISTRY.

At the Annual General Meeting of the Institute of Chemistry held at 30, Russell Square, on March 3, Professor Arthur Smithells, the President, in moving the adoption of the Report of the Council, made some observations on the question of chemical training, urging in particular that the burden now put upon the student was excessive and too apt to result in undigested knowledge of what was regarded as the higher things of chemistry, with accompanying neglect of what was more simple and basic. He thought the time was overdue for a thorough reconsideration of the question. He referred to the successive marches of chemistry that had taken place in less than a lifetime, and the great difficulty that resulted in adjusting the new and old clain on the curriculum. He thought that the courses had become congested and the pace too rapid. He acknowledged the great improvement that had taken place in our schools of chemistry at home. It was no longer necessary to go abroad for the latest or the best in any division of science; we were in a way doing too much rather than too little. He alluded at some length to the ways of teaching and work which prevailed in Bunsen's laboratory at Heidelberg as illustrating the kind of conditions under which he believed, the early training of the chemist might be more satisfactorily conducted. The President said he had only touched o

one part of a very large question and was concerned to arouse interest in it rather than to lay down any law. He thought that the education of the professional chemist was really an important question of the day and it called for the most careful consideration. He strongly advised all who had any responsibility in the matter to read a small book which had recently appeared under the title of "Education at the Cross Roads." It dealt to some degree explicitly with the subject, but it had much greater importance in stating the present material problems in education with unusual clearness and perspicuity. The author, Lord Eustace Percy, late Minister of Education, offered a temperate criticism and a real constructive statesmanship in describing the educational changes which he advocated.

The Report of the Council showed that the roll of the Institute bad increased by 156 members and 20 students, that the Institute was in a sound position financially and that the Committees of the Council and Local Sections had been actively engaged in the interests of the profession of Chemistry.

The Meldola Medal was awarded to Dr. Richard Alan Morton, of Liverpool, and the Sir Edward Frankland Medal and Prize to Mr Bernard William Bradford.

The Officers and Members of Council for tbe ensuing year were elected,—Dr. G. C. Clayton, C.B.E. being elected President in succession to Professor Smithells who has occupied the Chair during the past three years.

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ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

At the last meeting on March 5, Mr. Brocklehurst (Chairman) reported that the list of samples analysed for members during the month of February had been submitted. The Consulting Chemist had reported on the proceedings of recent meetings of the Advisory Committee of the Ministry of Agriculture on the Fertilisers and Feeding Stuffs Act. Further information had been given to the Committee by Dr. Voelcker on two cases of castor bean in linseed cakes referred to at the last meeting, but no settlement had yet been arrived at in either case.

Various matters arising out of his correspondence had been submitted by Dr. Voelcker.

The Oxy-Acetylene welding of cast-iron has now become an important part of the engineering industry; and every kind of machinery is now successfully repaired by this process. A copy of Messrs. Suffolk Iron Foundry's "Welding the World" (8s. 6d.) Booklet will be sent on application to their Gipping Works, Stowmarket, to any reader.

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504,312.—Fatty acids, sulphuric acids and oleic acid, all being chemical substances for use in fanufactures.—Naamlooze Vennootschaap de Stearine Kaadrsenfabriek "Apollo" Voorhavenkade 6 to 8, Schiedam, The Netherlands. February 12. (Associated.)

SUPERVINO.

509,587.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—George M. Callender & Co., Ltd., 25, Victoria Street, London, S.W.1. February 19th.

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508,701.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives.—Charles John Beharrell & Sons, Boundary Bridge, London Road, Barking, Essex. February 19th.

DIDO.

505,027.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives, but not including paints, colours, varnishes or enamels (in the nature of paints), and not including any of a like kind to any of these excluded goods.—Kay, Brothers, Ltd. St. Petersgate Mills, St. Petersgate, Stockport, February 26th. (Associated.)

VAX.

506,337.—Spraying preparations, being chemical substances for horticultural purposes.—Henry Wells Oil Co., Ltd., 11, Haymarket, London, S.W.1., and Imperial Oil Works, William Street, Salford. February 26th .

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THE COLLINSICS OF MINERALS. XV.

By Hawksworth Collins, B.A. (Camb.)

The following twelve collinsics each contain *one* or more atoms of Pb of which the relative volume at 15° C. is 19.81 and the optical refractivity 35.459. This is the only new voloptic introduced.

In cerussite (No. 169) the first line gives the chemical formula and the theoretical specific gravity at 15° C. followed by the experimental S.G. The second line gives (between the brackets) the R.V. of each atom, and also the product of their sum and $\mu-1$. The third gives the theoretical refractive index μ followed by the experimental R.I. The fourth gives the optical refractivity of each atom and also their sum.

There are four voloptics in this mineral, 19.81 and 35.459; 8 and 3.333; 7.53 and 1.654; 2.51 and 1.346; *i.e.*, four pairs of values which are invariable at 15° C. in every mineral in which they occur. This means that, whenever 19.81, *e.g.*, occurs as the relative volume of Pb in a mineral, its O.R. is always 35.459. These four voloptics have occurred 31, 20, 258 and 1360 times respectively in the first 180 collinsics.

There are three colls in cerussite, as in all other minerals :— (*a*) The molecular weight when divided by the sum of the R.V.'s gives a result (6.59) which is within 1 per cent. of the experimental S.G.; (*b*) The theoretical μ (2.0688) is within 1 per cent. of the experimental; (*c*) The sum of the O.R.'s in the fourth line corresponds to four figures with those directly above it in the second line.

Each collinsic is, therefore, an exact discovery which shows the relation between chemical formula, molecular weight, specific gravity, relative volume, refractive index of molecule, and optical refractivity of each atom; and each one is also a separate proof that the correct R.V.'s and O.R.'s have been found.

Cerussite is one of the few minerals of which the Heat of Formation has been experimentally obtained. The H.F. of each atom in the molecule was discovered several years ago, and was published in the *Chemical News*, 1926, cxxxii, 87 and 265.

The collinsic of cerussite is made infinitely more certain by adding the following two lines to it :—

H.F. 170189 = −40607 − 13855 + 32341 + 96155₂
17000 = experimental value given in some books.

The two following paragraphs explain the law of heat of formation in the case of cerussite.

11.33 (Kupffer) and 11.346 (Creighton) are two experimental values of the S.G. of Pb. If the at. wt. 206 be divided by 11.34, the result is 18.17, which is the rel. vol. of an atom of Pb in its free (original) state. It is the original state as far as experiments in H.F. are concerned. 18.17 was shown to be correct for other reasons when the structure of Pb was under consideration in the *Chemical News*, 1926, cxxxii, 87. The change of volume of the atom of Pb in leaving its original state and entering into the molecule $PbCO_3$ is therefore 1.64 (19.81 − 18.17). It has increased in volume and has therefore absorbed heat. By the law of H.F. which was shown to be true (in the *Chemical News*, 1926, cxxxii, 265) in the cases of nearly all the elements concerned in experimental work, if the change of volume be multiplied by the constant 120 and also by the at. wt., the H.F. of the atom is obtained. The result is −40607. The constant is 120 for all elements of greater at. wt. than 22, *i.e.*, for all sodium elements; but for subsodium elements it is enormously different, *viz.*, 795.

1.80 (Playfair) and 1.84 (Griffith) are two experimental values of the S.G. of C. If the at. wt. 12 be divided by 1.833 the result is 6.548, which is the rel. vol. of an atom of C in it original state as charcoal. The change of vol. in entering into $PbCO_3$ is 1.452 (8 − 6.548). As this is an increase, heat is absorbed. If the change of vol. be multiplied by 795 and also by 12, the result is −13855 small calories. Similar matters with regard to oxygen have frequently been demonstrated in this periodical, but especially in 1924, cxxviii, 230, when the structure of O was under consideration.

TABLE XXI.

THE COLLINSICS OF TWELVE MINERALS.

	Theor. Column at 15°C	Obs. Column
(169) Cerussite $Pb + C + O + O_2$		
43.137 = 1.0688(19.81 + 8 + 7.53 + 2.51_2)	**6.59**	6.574 D
	2.0688	2.076 D 1.8037 D
43.138 = 35.459 + 3.333 + 1.654 + 1.346_2		
(170) Phospenite $Pb_2 + CO_3 + Cl_2$	**6.01**	6.0-6.09 D
100.277 = 1.11(19.81_2 + 20.55 + 15.085_2)	**2.11**	2.114 D
100.237 = 35.459_2 + 7.679 + 10.82_2		
(171) Mendipite $Pb_3 + O + O + Cl_2$	**7.098**	7.0-7.1 D
131.44 = 1.294(19.81_3 + 7.53 + 4.45 + 15.085_2)	**2.294**	N_m2.27W N_g2.31W
131.418 = 35.459_3 + 1.654 + 1.747 + 10.82_2		
(172) Lanarkite $Pb_2 + S + O_3 + O_2$	**6.33**	6.3 D 6.35 M
84.324 = 1.0189(19.81_2 + 15.53 + 7.53_3 + 2.51_2)	**2.0189**	1.93-2.02 S N_g2.01 W
84.322 = 35.459_2 + 5.75 + 1.654_3 + 1.346_2		
(173) Pseudoboleite $Pb_5 + Cl_{10} + Cu_4 + O_4 + 6H_2O$	**4.85**	4.85 W
383.186 = 1.0283(19.81_5 + 15.085_{10} + 7.13_4 + 2.15_4 + 14.03_6)	**2.0283**	N_o2.08 W
383.191 = 35.459_5 + 10.82_{10} - 13.22_4 + 1.346_4 + 6.572_6		
(174) Litharge $Pb + O$	**9.15**	9.13 W
37.200 = 1.5334(19.81 + 4.45)	**2.5334**	N_e2.535 W
37.206 = 35.459 + 1.747		
(175) Paralaurionite $Pb + O + H + Cl$	**6.0**	6.05 W
50.235 = 1.1638(19.81 + 2.51 + 5.76 + 15.085)	**2.1638**	N_m2.140 W
50.238 = 35.459 + 1.346 + 2.613 + 10.82		
(176) Finnemanite $Pb_5 + Cl + As_3 + O + O_8$	**7.26**	7.26 W
253.863 = 1.286(19.81_5 + 15.085 + 19.58_3 + 4.45 + 2.51_8)	**2.286**	N_o2.295 W N_e2.285 W
253.88 = 35.459_5 + 10.82 + 17.75_3 + 1.747 + 1.346_8		

	Theor. Column at 15°C	Obs. Column	
(177) Margarosanite Ca + Pb + Si_3 + O_4 + O + O_4	**3.978**	3.99	W
91.79 = 0.7703(13.25 + 19.81 + 13.83_3 + 7.53_4 + 4.45 + 2.51_4)	**1.7703**	N_m1.773	W
		N_p1.729	W
91.796 = 13.25 + 35.459 + 9.78_3 + 1.654_4 + 1.747 + 1.346_4			
(178) Melanotekite Pb_3 + Fe_4 + Si_3 + O_{13} + O_2	**5.712**	5.7	W
239.42 = 1.173(19.81_3 + 10.08_4 + 13.83_3 + 4.45_{13} + 2.51_2)	**2.173**	N_m2.17	W
239.44 = 35.459_3 + 19.58_4 + 9.78_3 + $1.747._{13}$ + 1.346_2			
(179) Hydrocerussite $Pb(OH)_2.2PbCO_3$			
Pb + Pb_2 + C_2 + H_2 + O + O_2 + O_5	**6.8**	6.8	W
122.952 = 1.0829(17.42 + 19.81_2 + 8_2 + 5.76_2 + 7.53 + 4.45_2 + 2.51_5)	**2.0829**	N_p2.09	W
		N_e1.94	W
122.952 = 28.264 + 35.459_2 + 3.333_2 + 2.613_2 + 1.654 + 1.747_2 + 1.346_5			
(180) Barysilite Pb + Pb_2 + Si_2 + O_3 + O_2 + O_2	**6.707**	6.72	W
		6.55	D
126.19 = 1.0767(19.81 + 17.42_2 + 13.02_2 + 7.53_3 + 4.45_2 + 2.51_2)	**2.0767**	2.070	S
126.195 = 35.459 + 28.264_2 + 11.53_2 + 1.654_3 + 1.747_2 + 1.346_2			

The at. wt. of Pb *is generally given as* 207.2 when that of oxygen is 16. It used to be given as 205.5 when that of H is unity.

In the collinsic of cerussite (including the H.F.) there are thirteen pairs of figures, which correspond either with one another or with other figures in other minerals. The three colls are pairs which correspond with one another, *i.e.*, the one of a pair with the other. There are always as many voloptics *as there are atoms* in the molecule, *five* in this case. And there are also as many heat-formation results as there are atoms, and they are invariable in other molecules, *e.g.*, if the volume of Pb is 19.81, its H.F. is −40607 in every substance.

These matters concern the whole of the collinsic; there are no other figures at all in it, so that it is evident that every part of a *collinsic is important*, and *there is no possi*bility of any jugglery with figures. But although there is apparently nothing else, there is in reality *an enormous amount* of further fundamental discoveries in them connected with the laws of relative volume, heat of formation, and optical refractivity, which will between them lead eventually *to the solution of the problem of the Struc*ture of Atoms.

It should be noticed that, when an element has several combining volumes, these do not denote a weakening of the matter, but a very great strengthening, because each change of volume is shown to have a corresponding change of heat of formation in accordance with the law, and also a corresponding change in the O.R.

If some one attempts to find the collinsic of a mineral with the voloptics already given, and comes to the conclusion that it is impossible, it does not follow that the collinsic cannot be discovered, because there are some common voloptics which have not yet been demonstrated.

In No. 170, CO_2 is the same as in 169.

The Gladstone-Dale formula for O.R. has been found to be the right one.

Summary.

Cerussite is the first Super-collinsic to be *published. This word denotes a collinsic* which is corroborated by the law of heat of formation, or by some other means. Attention will be confined to super-collinsics in the next few papers.

The first four super-voloptics are as follow :—

(a) When an atom of Pb has the relative volume 19.81 in any mineral, its O.R. is 35.459, and its H.F. is -40607.

(b) When an atom of C has the rel. vol. 8, its O.R. is 3.333, and its H.F. is -13855.

(c) When an atom of oxygen has the rel. vol. 7.53, its O.R. is 1.654 and H.F. 32341.

(d) When an atom of oxygen has R.V. 2.51, its O.R. is 1.846 and H.F. 96155.

The collinsic of cerussite is corroborated exactly by the H.F. owing to the fact that the H.F. of each atom is calculated from its combining volume in this mineral (see Table XXII), and the algebraic sum of them all is the amount found by experiment.

LAW OF HEAT AND FORMATION.

H.F.		Constant		Change of Vol.	At. Wt.	Orig. Vol.		Combining Vol.	Change of Vol.
-40607	=	120	×	(-1.64)	×206	18.17	=	19.81	- 1.64
-13855	=	795	×	(-1.452)	× 12	6.548	=	8	-1.452
32341	=	795	×	2.54	× 16	10.07	=	7.53	+ 2.54
96155	=	795	×	7.56	× 16	10.07	=	2.51	+ 7.56

The exact product of 120, 1.64 and 206 is 40540.8. The change of volume would have to be 1.6427 in order that the product may be 40607. This implies that the original and combining volumes must be calculated to four decimal places, but it is not proposed to attempt this until many more collinsics have been published.

ANNUAL REPORT ON THE FERMENTATION INDUSTRIES, 1929.

(Prepared for the Society of Chemical Industry and the Institute of Brewing.)

By H. LLOYD HIND, B.Sc., F.I.C., AND F. E. DAY, B.Sc., F.I.C.

(*Continued from page* 183).

The source of the enzymes in developing grain provides problems of considerable interest and the classical work of H. T. Brown and Escombe in this connexion is well known. Recently J. Gruss has confirmed their conclusions by allowing barley embryos to grow in contact with a sheet of absorbent paper impregnated with starch solution and afterwards applying appropriate reagents. He showed that peroxidase was secreted from the scutellum and alenrone cells as well as diastase. In addition to these enzymes the aleurone cells were found to secrete cytase, invertase, and proteolytic enzymes, which he termed peptase and tryptase, and also what was probably not an enzyme but a substance of the aromatic series which he called "antioxidasin" and considered to be responsible partly or wholly for the odour when malt is kilned. Its function may be to prevent auto-oxidation of diastase.

H. Lüers and L. Malsch have made some interesting observations on cytase, which is so important in attacking the cell walls of the endosperm during malting. Its activity was measured by hydrolysis of xylan hydrolysis was practically proportional to the enzyme concentration. They followed the course of the changes in its activity during malting and found that whilst it diminished somewhat during steeping it increased rapidly during germination, attaining finally a value abut 2.5 times that oof the original barley. Towards the end of kilning the activity falls very rapidly, with the result that the value for the finished malt is lower than that for the original barley.

The inorganic phosphates which play such an important part in yeast metabolism and industrial fermentations are almost entirely derived in the brewing from organically combined phosphoric acid in the original barley. The ahosphatases which bring about the liberation of this phosphoric acid are consequently of immense importance. H. Lüers and L. Malsch have studied the conditions of formation and of activity of four types of these enzymes. These were saccharophosphatase which decomposes the phosphoric esters of sugars, glycerophosphatase which decomposes the glycerol phosphoric ester formed by the hydrolysis of lecithin and other phosphatides, phytase which converts phytin into the cyclic sugar inositol and phosphoric acid, and finally nucleotidase which sets free the phosphoric acid combined in nucleic acids. The optimum temperatures for these enzymes were found to be 36° for glycerophosphatase, 41.5° for saccharophosphatase, and 48° and 49° for phytase and nucleotidase. The pH optima are 5.2, 6.0, 5.2—5.3, and 5.6 respectively.

Hydrogen-ion Concentration in Brewing Processes.

The significance of hydrogen-ion concentration as a factor controlling the activity of enzymes was referred to in the last section; as the fermentation industries are based so largely on enzymic changes, methods of control based on the present state of knowledge and with convenient means of measurement are being gradually extended in practice. The influence of reaction is felt at every stage of the process from the growth of the raw materials to the delivery of the final product . Problems of soil acidity are for the agriculturalist and the fermentation industries are concerned with hydrogen-ion concentration first either in the direct utilisation of the raw materials or, in the case of cereals, during their conversion into malt.

The changes which occur in barley during malting may be studied from several aspects among them that of the transformation of its constituents and that of variation in activity of the enzymes which bring about these chemical changes. Reference has already been made to the work of Bishop on the breakdown of the proteins and to that of Lüers and Malsch on cytase and the phosphatases.

Hopkins and Kelly found that about half of the original buffers of the barley are extracted during steeping and that the extracted matter is of relatively alkaline character. This observation may have some reference to the different views on steeping expressed by Moufang and Chabot and emphasises the desirability of further work on the effect of the composition and reaction of the steep liquor on the malt. They found that the buffering due to phosphates and protein degradation substances increases from the second day on the floor to kiln loading. After this little change occurs in th ebroad buffering zones measured, though an increase is noted during kilning in a narrow range about p_H4.4, which in the main represents amino-groups. During flooring the p_H rises rapidly at first, but becomes constant after about six days, falling markedly on the kiln. Considered as buffers the inorganic phosphates and nitrogenous degradation products, the formation of which is indicated bv these authors' curves, are of considerable importance in brewing through the control they exercise over hydrogen-ion concentration, and quite apart from their availability as yeast nutrients.

The view is now generally taken that liquor treatment is essentially a question of acidity, acting either directly or through reactions between the dissolved salts and malt constituents, and it cannot be dealt with without consideration of the nature of the water in conjunction with that of the materials. The principles on which the treatment of brewing liquor depends have been dealt with in several communications during the year. A discussion of the subject by H. Lüers includes some interesting experimental results. Brewings were made with the same grist and under nearly as possible identical conditions, but with the same water treated in several ways. He He quotes very full analysis of both worts and beers, and in the main these show the effects of increased enzyme action during mashing with increased acidity. The mashes were carried out by the decoction process in which the differences produced by varying acidity are less marked than in the infusion method, as is seen from examples of the latter which he gives. As would be expected, acid treatment of the liquor raised acidity, extract, nitrogen and phosphates in the worts and beers, though not to a pronounced degree. On the other hand, the flavours of the finished beers were found to be strongly influenced by the water treatment. The original water had a hardness of 27°, of which 25° were due to carbonates. Brewings were made with the untreated liquor with the water after lime treatment to reduce the hardness to 7°, the same with the addition of gypsum equivalent to 11° of hardness, and with the water in which carbonates were completely neutralised with lactic acid. In addition, lactic acid was added to the copper in a brewing with the original lisuor in such amount that the p_H of the wort was reduced by 0.26. The beer from the untreated liquor had a rough, coarse, harshly bitter flavour and a reddish -yellow colour. That brewed with water softened by lime was better in colour, and had a fine, full, bitter flavour. The liquor treated with gypsum gave a beer which, though an improvement on that from the untreated liquor, had a cold, hard flavour. This was attributed to too much gypsum and subsequently better results were obtained by reducing it to an amount equivalent to the remaining carbonate hardness. It is stated that Jalowetz has expressed the opinion that this treatment is correct, but much greater quantities are used in English practice based on analyses of Burton waters. Lüers observed that beers brewed with gypseous waters came into condition more quickly than did beers from normal waters

Though the two worts and beers which had received lactic acid treatment showed considerable differences on analysis, that in which the acid was added to the copper approximating to that brewed from the untreated liquor, the other to the beer from softened water, they were astonishingly similar in and flavour colour. They had the lowest colour of the whole series and an extremely mild flavour, and are said to have give nthe impression that with a higher hop rate a particularly fine flavoured beer would have been produced. V. Koudelka also comments on this mild hop flavour, which supports the idea that this is a usual effect of acidity. and may be attributed to lessened dissolution of the resins.

Although acid treament provides the simplest means of overcoming the disadvantages of carbonate alkalinity, the addition of strong mineral acids to water must be most carefully controlled as excess may be disastrous. For this purpose the automatic device described by D. McCandlish and G. Hagues should prove of great practical utility. By its employment the calculated quantity of acid can be continuously added to large volumes of water. Lactic acid has the advantage that a slight excess has no harmful effects on the beer since it causes an during mashing, thereby correcting the final increased formation of buffer substances reaction.

The changes which take place in the mash tun, being almost entirely of an enzymic nature, are to a high degree dependent on the " active " acidity, but as the many enzymes of malt have widely different temperature and p_H optima the conditions adopted in practice must, to a considerable extent be in the nature of a compromise. In this couutry the generally used infusion mash limits the possible temperatures to the range 60—70°. This is determined by the optimum for extract production and is further limited by the fact that the proportion of fermentable sugar decreases as the temperature is raised. Expressed in relation to enzyme action, this range covers the temperature optima of the dissolution and saccharification of starch by diastase. It is usually considered, on the basis of the hydrolysis of starch solutions at lower temperatures, that the optimum p_H for this is about 4.7, but it is now generally recognised that p_H optima are acected appreciably by other conditions.

Still another important change is the liberation from malt by phosphatases. Of the four phosphatases recognised by Lüers and Malsch only one is likely to be of importance in the mash tun, and that is phytase. They showed that this enzyme is most active at 48° and p_H 5.2—5.3. Thus the mashing conditions already considered best are also favourable to its action. Unfortunately neither Hopkins nor Windisch and his collaborators determined the phosphates in their mashes, but the latter's buffer titrations suggest an optimum at about p_H 5.0. Although in most cases in which the amount of phosphate before and after fermentation has been determined it has been shown that the greater part remains in the beer, it is not certain that the amount of this excess is of no value otherwise than as a buffer. On this point reference may be made to the sugegstions of Schoen.

Most malts when mashed with distilled water yield worts having a p_H abont 5.7 and it is therefore usually desirable to take steps to increase the acidity, especially if mashing lquor containiug carbonates is used. The treatment of liquor has already been referred to. Direct additiou of lactic and other acids to the mash is made in some cases, but we are not aware of any record of the employment of a nacid or alkaline underlet which might in certain cases be useful if it is desired to alter the reaction during later stages of the process.

Within the range of acidity investigated it has been always recognised that decreased acidity leads to high wort colour and that this effect is increased during the boil. This increase of colour is especially marked when watercontaining carbonates is used for sparging. H. Stadler has shown that as the acid substances are washed out from the grains the slight acidity of the weak wort is completely neutralised by the carbonates and colouring matter of an undesirable reddish shade is dissolved in an amount out of all proportion to the low concentration of solids. At the same time such waters dissolve an undue amount of undegraded protein and this is very liable to reappear later as beer turbidity. The outlines of the principles on which the control of mash tun reaction can be based are thus well defined, but an immense amount of detail has to be filled in. F. Emslander in discussing the results of Windisch, Kolbach, and Banhilzer, which he in general confirms sounds a note of warning against the presumption that the question of acidification is settled. In the present state of knowledge it is by no means certain that in deciding on the acidity conditions to attain one object, a new difficulty will not be introduced.

THE INSTITUTE OF METALS. PRESIDENTIAL ADDRESS.

Delivered by P. SELIGMAN, Ph. nat.D.
March 12, 1930.

Those of you who have listened to a number of Presidential Addresses in this room will have noticed that they almost always fall into two parts. In the first the President gives his views on what may be called current problems; the second is usually devoted to the discussion of some problem of interest to the Institute, and yet connected with his own life work. Thus, for instance, Engineer Vice-Admiral Sir George Goodwin discussed the application of non-ferrous metals to naval architecture; whilst Sir Harold Carpenter, to quote another example, gave us the fruit of his long experience in the training of the metallurgists of the future.

When I look back over the thirty years which have passed since I left the University to take up industrial work, it seems to me that my whole working life has been devoted to the one object of transmitting the lessons learned from the distinguished scientists who were my teachers to a number of industries in which scientific methods of thinking and working have, until recently, made but little headway. Such an experience and the further lessons learned in its course might well form the subject of a Presidential Address. It seems to me, however, that at the present moment the Institute is faced by a problem which is great enough to demand that we devote the time at our disposal to its consideration. I prefer, therefore, to examine, as best I can, the new obligations imposed upon us by the fact, gratifying in the highest degree, that our Institute, in the short space of twenty years, has developed from a small body of English enthusiasts into an international institution, with a membership spread all over the civilised world. For, believe me, ladies and gentlemen, our very success has brought in its train new problems which must be solved, new duties which must be discharged, new difficulties which must be overcome, if we are to extend the splendid work which those who founded the Institute and those who have thus far carried it on, have so admirably performed.

It is well known to us all—it emerges from the Report which you have just heard—that of our total membership more than one-third is resident abroad, many in British Dominions overseas, but by far the greater part in countries which owe no allegiance to the British Crown. Moreover, the proportion of overseas members is growing rapidly —a fact which we must welcome if we have at heart the welding together of all those who ply our craft, irrespective of their origins or their habitations. However welcome such a development may be, it seems obvious that it must, sooner or later, lead to modifications in our structure, in our very ways of thought, and it behoves us not to let such changes take us unawares.

What is the nature of the problem as it affects us? Clearly it is of the same nature as that to which I have already drawn attention in connection with our home local sections, but greatly magnified by such factors as distance, differences of language, differences of education, and, above all, those differences of outlook characteristic of the different nations. Our problem is complicated still further by the fact that we have to deal frequently with bodies of our members who are attached to other and not very different organizations in their own countries, and that it is essential for us to act so that while we secure and maintain their adherence to our Institute and ensure that they bring to us the strength and driving power which we shall always need, we do nothing which shall even bear the semblance of attempting to wean them from their allegiance to their own national institutions.

Just as with our home sections, we shall be faced more and more insistently with the necessity to devise means by which we at the centre can be kept in regular touch with the flow of opinion among these distant bodies of our membership, by which we can keep them informed of what is going on among ourselves and, if our work is to be truly constructive and enduring, to see to it that such information circulates from one section to another and not only between centre and periphery.

For as I see it—and here I speak, of course, for myself alone—our objective in the future will no longer be confined to the dissemination of non-ferrous metallurgical doctrine, but will include the creation of a solid body of metallurgical opinion throughout the world; the bringing into unison of all the elements which go to form such a body of opinion, ourselves playing the honourable part of the cement which shall bind the whole together .

Now it is clear that the problem is one of great complexity, and that it will require much earnest thought before a satisfactory solution can be arrived at. Moreover, we shall have to think on broad-minded lines, unselfishly, and with minds attuned to the

ways of thought of many peoples other than our own—attuned, in fact, to those world movements which are so prominent and auspicious a symptom of the day.

You will not expect from me a ready-made solution for a problem of such magnitude, and indeed a solution arrived at by any one individual is not in the least likely to be either satisfactory or permanent. We shall have to hammer it out in council with one another, and shall require the help of all and sundry in our difficult task.

It may, however, be opportune to examine one or two of the agencies which are already at work in the direction in which it seems we ought to go, and that, with your permission, I propose to do. If, in the course of this examination, I suggest one or two ways in which these agencies might be strengthened, such suggestions are meant to be only provocative of thought and discussion, and I would beg you, and especially my fellow-members of Council upon whom will fall the burden of solving the problems before us, to regard them only as such.

At the outset ,let me refer to the conference no wtaking place under the chairmanship of the immediate Past-President, which has the co-ordination of research in various countries for its object. This movement was initiated by Dr. Rosenhain at a dinner given in our honour by the Deutsche Gesellschaft für Metallkunde at Düsseldorf, and received an immediate and hearty welcome from the metallurgists of many nations there assembled. It was thought that it would be possible to conduct the deliberations of this conference under the ægis of our Institute, but it soon appeared that this was at the moment ipracmticable; and though Dr. Rosenhain and I very much regretted this fact, we both saw the force of the objection raised. Therefore, we felt justified none the less in pledging the full assistance of the Institute—a pledge which has since been confirmed by the unanimous vote of the Council.

For the present this movement is designed, I believe, to provide means for keeping those engaged on non-ferrous research in the various countries informed as to what is going on in other countries, and so to prevent unnecessary overlapping and the irritation sometimes caused when work done in one country is apparently ignored by the scientists of another.

Such a movement seems to be full of promise, provided only that its authors recognize the limitations which the conditions of the day impose upon it.

They must recognize, to give only one example, that with the organization of industry as it is emerging from the regrouping and reconstitution which is now in progress, there are arising research bodies attached to the great combines, which are, themselves, doing a great deal of the work—even fundamental research—which heretofore has been within the special field of individuals and the Universities. With the best will in the world such bodies will, in many cases, be prevented from communicating their plans to others. It would often be quite enough for an astute commercial rival to know that a certain laboratory was proposing to work on a subject, to make him realize that in that direction some great technical prize was awaiting him, and for reasons such as this it will be thought necessary to keep plans secret as long as possible.

If this and similar limitations of the moment are recognized from the start, we can confidently look for great benefits from Dr. Rosenhain's committee, and we may hope that before our present meeting ends he will be able to tell us that it is on the way to permanent establishment with its immediate objectives well in view.

A second agency which is capable of helping our cause forward, and rapidly at that, is the body of men distinguished in one branch or another of our art who, in many countries, are co-operating with us in promoting the objects for which we exist. I refer, of course, to the Honorary Correspondents of the Council with whom we have now, to quote the poet, " put a girdle round about the earth," for in no fewer than fourteen countries are we fortunate enough to be represented in this manner.

Here, too, there is work to be done if we are to take full advantage of this unique company of helpers. Obviously, some of the steps in course of preparation and some of the suggestions made for associating our home local sections more closely with our work can find application here; notably the regular dissemination of news to our distant friends, to which I have already referred, should prove welcome and helpful. On the other hand, it will obviously be impracticable to secure the personal contact which is so desirable and, in the case of our home local sections, possible. It is striking, however, on looking at the distribution of our overseas membership, to see how many cases there are where considerable numbers reside in the same city, or at least within closer distance of one another than many of our London members travel daily between

their homes and their work. There are ten or more places where groups of 20 to 30 or more members could readily foregather, and it may be asked whether it would not be possible to extend the local section idea to such places and so secure regular meetings of our overseas members among themselves. Twenty is not a large number for such a purpose, but it is one of the great advantages of a local section that it need not be limited to full members of the Institute. On the contrary, we welcome to the meetings of these sections associates who are frequently young men not yet able to defray the cost of full membership, but to whom we look with confidence for the recruits of future years. Twenty regular members, if keen and active, would be a splendid nucleus for a section so composed, and such a section should be able to do excellent work, not only for its own members but for the Institute at large as well.

Again, there seems to be no reason why the process of co-operation with the local branches of other and kindred societies, already a notable and highly successful feature of some of our home sections, should not be applied to the new sections which I should like to see spring from these groups of our overseas members. If such sections could be formed and the Council's Honorary Correspondents be supported by local committees, we should find it much easier to reach our members, however distant from us, to help them hy securing that they were kept in touch with metallurgical thought throughout the world, an dto secure from them new thoughts, new views and, therefore, added strength for the performance of our task.

Where we enter the realms of pure science nationality ceases to exist and, as the poet says, " we know nor border, no breed nor hirth." In those realms, therefore, we can all work together, untroubled by competition except for the advancement of our common cause, or by jealousy except of anything that may hinder the advancement of the art, of which we are all, according to our measure, the servants.

NOTE ON THE SPECTROSCOPIC IDENTIFICATION OF EKA-CÆSIUM.

(SUPPLEMENTARY REMARKS.)

By F. H. LORING.

In the article of last week, pp. 178-181, the suggested ionisation potential of eka-cæsium (p. 181) was given as 3.75 volts. This should read 3.57. Plotting a curve with the values given for K, Rb, and Cs gives the value 3.57. These values are, of course, calculable from the first constants of the formulæ, so that 29013/8102 = 3.5809. 8102 is the common constant given by Fowler in his report, page 70. This shows a very good agreement that helps to substantiate the new constant 29013.

In inking in the middle curve (p. 179) the present writer made the line where joining 37.5 to 69 with a very little less curvature than should be the case for a truly-drawn curve. *This does not change the values.*

It is doubtful whether a common zero would do, although suggested as an alternative in the addendum on page 181.

ENERGY AND FORCE.

By " AN IGNORANT STUDENT."

Energy is a tendency to move and movement in a four-dimensional space may be in either of two directions, inwards or outwards.

Movement of a single unit or material body, however, tends to be lineal and in a direct line, and therefore where there are many units moving outwards from a common centre their movements will be radial. There will be pressure, a material force, radiation.

Where, however, there is movement from two centres and so partly in opposite directions and toward each other there will be not only pressure but also resistance, a conflict and interference. There will be compression; there is a pair of forces.

If the Electron is an effect produced by a combination of two opposite forces of Energy in four dimensions of space, one acting inwards and the other outwards there will be pressure and resistance between them. The inner force is tending outwards and the outer force is tending inwards—as in the case of the egg and its shell, which provides a solid resistanee.

We therefore can easily see how an Electron may become accelerated and have velocity like Light, for the Electron has no shell containing it, and therefore there is little or no resistance; or it may be retarded and owing to compression by the Energy tending inwards become stabilised and in effect denser and even have weight — like solid Matter which has Gravity.

SCRAP IRON AND STEEL FROM FRANCE.

A total of 30,000 metric tons of scrap iron and steel has again been allocated for distribution among United Kingdom importers during the current year by arrangement with the French Government.

GENERAL NOTES.

INCREASE IN CANADA'S MINERAL OUTPUT.

An official bulletin issued to-day gives revised figures for the value of the output of the mining industry in Canada in 1929 at 307,146,000 dollars, which is nearly four million dollars above the preliminary estimate of January and an increase of 11.69 per cent. over the figures for 1928.

High peaks of production were recorded for gold, copper, nickel, zinc, petroleum and building materials. The value of the metals group was nearly twelve million dollars higher at 153,694,000 dollars. Fuels were 2,300,000 dollars higher at 76,722,000 dollars. Other non-metallics were 1,872,000 dollars higher at 18,826,000 dollars and structural materials 6,300,000 dollars higher at 56,031,000 dollars. In the order of their production value in 1929, the leading minerals were : coal, copper, gold, nickel, cement, lead, asbestos, clay products, silver, zinc, stone, natural gas, lime, petroleum, gypsum, cobalt salt and platinum. In 1928 the latest year for which world data are available, Canada produced 94 per cent. of the world's nickel, 69 per cent. of the world's asbestos, 55 per cent. of the world's cobalt, 9.6 per cent. of the world's gold, 9.2 per cent. of the worlds lead, 8.5 per cent. of the world's silver, 5.2 per cent. of the world's zinc, and 5 per cent. of the world's copper output. The Government will henceforth issue monthly statistics of production for the sixteen leading minerals of Canada.

The Dominion Bureau of Statistics has issued a booklet giving a detailed analysis of Canadian mineral production for 1929.

MINERAL EXPLORATION WEST OF HUDSON BAY.

North of the Churchill River Basin and east of the Mackenzie River basin lies a wide expanse of so-called " Barren Lands " which has been, until recently, the " noman's land " of the prospector. Difficulties of access and travel virtually prohibited the exploration of its resources. Since 1927, however, according to Dr. L. J. Weeks, of the Geological Survey, Dominion Department of Mines, Ottawa, two main features have contributed to the opening and at least the preliminary exploration of this territory.

The first of these was the announcement that the Hudson Bay Railway would be completed, which awakened interest in the potential wealth of the country it traversed and approached. The second was the introduction of aircraft in the north. The use of pontoon-equipped aeroplanes gave easy access to the lake-dotted country of the Precambrian Shield and afforded a speedy means of transportation for men and supplies. The cost of prospecting in this belt of territory practically excludes the individual prospector and has led to the formation of several large companies, well staffed and thoroughly equipped to carry on extensive explorations by aeroplane and canoe, with bases established at various points to meet all the exigencies of their sometimes hazardous undertakings.

IRISH FREE STATE PASSENGER MOVEMENT.

The returns for 1929 show that the whole of the direct passenger movement between the Irish Free State and non-European countries in 1929 was to and from the North American Continent and that 91 per cent. of this traffic was with the United States.

WHOLESALE PRICES IN FEBRUARY.

A decline of 2.4 per cent. from the previous month, and of 7.7 per cent. from the corresponding month of last year, is shown in the index number for February, which is returned as 76.9.

EXAMINATIONS FOR CERTIFICATES OF COMPETENCY.

Examinations for first and second class certificates of competency as managers and under-managers of mines will be held on May 28 and 29 at Edinburgh, Newcastle-on-Tyne, Sheffield, Wigan, Cardiff and Birmingham.

The written part of an examination for certificates of qualification as surveyors of mines will be held at the same centres on May 29.

Applications for the necessary forms should be made as early as possible and not later than April 15. In order that the appropriate forms may be sent, it is important that candidates should state whether they have already sat at one of the Board's examinations.

Letters should be addressed to the Secretary, Board for Mining Examinations, Mines Department, Dean Stanley Street, Millbank, London, S.W.1.

Proceedings and Notices of Societies

SOCIETY OF PUBLIC ANALYSTS.

54th Anniversary.

On March 4th the Society of Public Anal-/sts and Other Analytical Chemists held a)inner at the Savoy Hotel to celebrate the i4th Anniversary of the foundation of the Society .

The President, Mr. Edward Hinks, 4.B.E., B.Sc., F.I.C., who was accompan-ed by Mrs. Hinks, received the members and uests, and afterwards took the Chair at the)inner.

There were present about a hundred and ixty members and guests, the latter includ-1g the Rt. Hon. H. Greenwood, P.C., M.P., 1inister of Health; Rt. Hon. Lord Tomlin, '.C., (Lord of Appeal); Rt. Hon. Lord Rid-ell (President of the Medico-Legal Society); .t.-Col. Sir Arnold T. Wilson, K.C.I.E., '.S.I., C.M.G.; Lt.-Gen. Sir Wililam Furse, K.C.B., (Director of the Imperial Insti-ute); Dr. F. E.Smith, C.B., C.B.E. (Secre-ary, Dept. of Scientific and Industrial Re-earch); Professor J. F. Thorpe, C.B.E. President of the Chemical Society); Dr. H. .evinstein (President of the Society of hemical Industry); Professor Arthur mithells, C.M.G. (Past President of the In-titute of Chemistry); Mr. Percy Gates President of the Institute of Brewing); Sir)ouglas C. Newton, K.B.E.; Dr. A. E.)unstan (President of the Institution of 'etroleum Technologists); Mr. Arthur J. . Reavell (President of the Institution of 'hemical Engineers), Sir Edward Holland, .P. (Chairmau Surrey County Council); Ir. Ernest Hicks, M.A., (Master of the alters' Company); Professor G. T. Morgan,).B.E. (Dept. of Scientific and Industrial Research); Arthur R. Hinks, C.B.E. (Secre-ary, Royal Geographical Society); Mr. A. V. Monro, C.B., (Ministry of Agriculture nd Fisheries); Dr. J. M. Hamill, O.B.E. Medical Officer, Ministry of Health); Dr. .. P. Bedard (Chairman of the Pharmacop-eia Commission); Lt.-Col. J. F. C. Carter, '.B.E. (Metropolitan Police Force); Major sidore Salmon, M.P.; Mr. G. W. Morrow nd Mr. R. B. Pilcher, O.B.E. (Registrar, nstitute of Chemistry).

After the loyal toasts had been duly onoured, the President proposed the toast f His Majesty's Ministers, coupled with the ame of the Minister of Health. Mr. Hinks ai dthat since its inception the work of the ociety had had a close relation to the De-artment of Government over which the 1inister of Health now presided. That Minister and his colleague, the Minister of Agriculture and Fisheries, was responsible for the food laws, whilst the Public Analysts were the persons ultimately responsible for the carrying into effect of those laws. Chemists associated with other interests than those of the Public Analyst were also concerned with the food laws—he referred to the chemists of the food manufacturers and to many other chemists, even extending to those of the manufacturers of heavy chemicals. He welcomed the regulations made by the Minister of Health, and said that in the public interest more were needed. It was the business of the Society to solve the difficulties that had been encountered. Among questions, other than food, which were of common interest to the Ministers and to the Society was that of water supplies and river pollution. He assured the Minister that the Society, in the technical matters which were within its province, were anxious to do everything they could to aid him and his brother Ministers in their work of Government.

The Minister of Health, replying to the toast, said that food adulteration had become more subtle and required more extensive scientific skill to defeat it. He believed that in the end fraud and deception never had its way. He had the greatest belief in the power of knowledge, and he welcomed the contribution that the Society was making to scientific knowledge. Although Public Analysts were servants of the local authorities, the reports all came to him and he was in close touch with their work. With regard to food, the Public Analysts were the scientific police service. He was advised that improved social conditions depended principally upon housing, whilst others said that nutrition was the more important. He was glad to be the guest of the Society, for he had a real appreciation of the work they were doing and wished them all success.

Mr. E. Richards Bolton proposed the health of the Kindred Societies, to which Lord Riddell, President of the Medico-Legal Society, and Dr. H. Levinstein, President of the Society of Chemical Industry replied.

Lord Tomlin, in proposing the toast of the Society of Public Analysts and Other Analytical Chemists, dealt with the question of expert evidence. This evidence, he said, was meant to guide the court, and only in so far as it was divested of all partisanship was it valuable. The toast was responded to by the President.

Mr. A. Chaston Chapman proposed the health of the numerous and representative guests. He acknowledged the great debt

that chemists owed to Sir Arnold Wilson for his interest and driving force on their behalf. Referring to the drawing in *Punch* of an imaginary dinner of the Society, he said that they were pleased to welcome the artist, Mr. George Morrow, as their guest at a real dinner.

Sir Arnold T. Wilson, in replying to the toast, suggested the appointment of an Alchemist Royal, in view of the importance of Chemists to the State.

THE PHYSICAL SOCIETY.

"*The Diffusion Constant of Water Vapour.*" By W. E. SUMMERHAYS, B.Sc., The University of Birmingham.

Water vapour was allowed to diffuse down a vertical tube about 2 in. in diameter, a steady concentration-gradient being maintained from approximate saturation at the top to approximate dryness at the bottom. The gradient was measured with two katharometers at a definite distance apart and the was weighed. The result given is 0.281 cm. mass of vapour passing in an observed time 2sec. at mean temperature 16.1° C.

A method of calculating the numerical equation of state for Helium below 6 Abs., and of estimating the relative importance of gas degeneracy and interatomic forces. By M. C. JOHNSON, M.A., M.Sc., Physics Department University of Birmingham.

Gas "degeneracy" (the effect of non-Maxwellian distribution of molecular velocities) is distinguished from gas " imperfection " (the effect of intermolecular forces), and it is shown that specific heat measurements cannot be used to verify theories of the former, unless account is taken of the very rapid increase of the latter at the lowest temperatures and highest pressures. Accordingly a thermo-dynamic method is used to calculate the sum of degeneracy and imperfection at 4° and 5° Absolute for helium. Theories of degeneracy can then be roughly tested by the extent to which they allow a residual value of the imperfection to be calculated, and to determine a consistent extension of the course taken by isothermals down to 15°. The method is applied to Fermi's expressions for degeneracy, and also to Berthelot's equation of state. One of the equation's alone satisfies the required condition, and it is shown that on this basis degeneracy would comprise 15 per cent. of the total departure of helium from ideal gas laws at 4° and 5°, the remainder being due to true imperfection or intermolecular forces.

The magnetostriction constant for alternating magnetic fields. By F. D. SMITH, M.Sc., A.M.I.E.E.

A magnetostriction constant K for the Joule effect is defined by the equation $p=KH$ where p is the alternating mechanical stress produced by a small alternating magnetic field H superposed on a steady magnetic field H_0. It is shown that the alternating intensity of magnetisation I produced by an alternating strain $\delta l/l$ is given by the equation $I \quad K\delta l/l$, K being the same constant in both equations. These equations are used to calculate the motional impedance of a laminated ring toroidally wound and vibrating in its fundamental radial mode. K has been measured for various values of H_0 with a ring of alloy Fe 60 per cent., Ni 40 per cent. It is shown that the magnetostriction effect for steady magnetising fields can be inferred from the measurements with alternating magnetic fields, if the reversible permeability of the alloy are known.

Model illustrating the mosaic theory of the compound eye. Lent by The Deparment of Zoology, University of London, King's College. Demonstration given by Capt. C. W. HUME.

The eye of an insect consists of a large number of tubes (ommatidia) formed with small lenses at their outer ends and associated with a retina at their inner ends, the number of ommatidia varying from 10,000 upwards. It has been suggested that each lens forms an independent image, the effects of all the images being combined as in the case of binocular vision. According to Altenburg, however, the lenses serve merely as condensers. Light from any point of the object can pass through that one of the ommatidia which is pointing directly at it, but is absorbed by the walls in th ecase of the other ommatidia. An erect image is consequently formed on the retina by the collocation of the narrow pencils of light admitted by different ommatidia.

Altenburg's model consists of a large number of contiguous straws, blackened to prevent internal reflection an darranged between a brightly coloured and illuminated object and a ground-glass screen. Each straw admits light from a small element of the object, and a faint but clear image is formed on the screen.

In the case of the insect eye the axes of the ommatidia are convergent towards the retina, instead of being parrallell like the straws. Thus the angular magnitude of the object is always the same for an insect, and the definition decreases in direct proportion to the distance of the object. The illumination of the insect retina is weak, as only a

very narrow pencil is admitted from each point on the object. The retina is probably more sensitive than the retina of vertebrates, but the loss of illumination may account for the inactivity of insects on cloudy days.

The next meeting was held on Friday, March 14, at the Imperial College of Science Imperial Institute Road, South Kensington, S.W.7.

The following papers were read :

A Harmonic Analyser. By J. HARVEY, A.R.C.S., B.Sc., City Guilds and Engineering College.

The paper describes a device for finding a given number of the Fourier components by means of successive weighings.

A Method of Comparing Small Magnetic Susceptibilities. By R. A. FEREDAY, B. Sc, East London College.

A method of the non-uniform-field type is described. It possesses the specific advantage that the force exerted on the specimen is constant over a wide region of the field, so that a careful setting to a position of maximum force is rendered unnecessary.

The Masses of the Proton and Electron. By H. T. FLINT, University of London, King's College.

A principle proposed by the author and described as the principle of minimum time is applied to yield an equation for the ratio of the masses of the proton and electron. The result obtained is in agreement with the experimental value. The possibility of explaining the assymmetry in regard to the masses by means of a metrical consideration is discussed.

NOTICES OF BOOKS.

Solvents. By THOS. H. DURRANS, D.Sc., F.I.C. Pp. xv.+144. London : Chapman ad Hall, Henrietta Street, W.C. 1930. Price 10s. 6d.

The rapid advances of the cellulose-lacquer and rayon (artificial silk) industries have stimulated an interest and an activity in technical solvents. This, in its turn, has stimulated scientific enquiry into the properties determining stability factors, especially in connection with colloidal bodies. The number and the bulk of solvents now produced annually is far in excess of the pre-war figures and thus the need for a book by an authoritative writer is real and has now been met by the present volume (No. 4), in a series of Applied Chemistry monographs edited by Dr, E. H. Tripp.

The author has concisely presented much information concerning solvent action, plasticising, solvent balance, diluents, viscosity, vapour pressure, inflammability and toxity in connection with the solvents. This constitutes Part I. of the book whilst Part II. is descriptive of the physical and chemical properties of individual solvents belonging to the homologeous series of hydrocarbons, alcohols, ketones, esters, glycols, chloro-compounds, etc.

The book is a treatise for the general reader especially, but there is a wealth of information which is also invaluable to the technical chemist concerned with the application of solvents.

The Advertisers Annual Convention Year Book, 1930. Pp. 624. London : Business Publications Ltd., Whitefriars House, Tallis Street, E.C. Price 15s.

This annual data volume which gives a very full list of the daily, periodical and technical press, should prove invaluable to all concerned with publicity and marketing. Various sections deal with the different categories of publications at home, abroad, and in the empire. There are also sections on advertising, publicity, printing, engraving, commercial art, displays, etc.

An account is given of the fifth advertising convention, held last year at Newcastle, and there are special articles from Lord Riddell and other authorities dealing with matters pertaining to the production and publication of periodicals and newspapers.

PUBLICATIONS RECEIVED.

UNION OF SOUTH AFRICA, DEPT. OF AGRICULTURE.

No. 70. An Economic Investigation into the Chicory Industry. By J. C. Neethling and C. H. Spames. Pp. 26. Price 8d.

No. 84. Sulphur Dioxide in Dried Fruit. By F. G. Anderssen. Pp. 14. Price 8d.

Forthcoming Events.

SOCIETY OF GLASS TECHNOLOGISTS.

Meeting of the Society of Glass Technology will be held in Stourbridge, on Tuesday and Wednesday, March 18 and 19, 1930.

PROGRAMME.

Tuesday, March 18 :—

6 p.m.—Standards Committee Meeting.

7 p.m.—German Visit Committee and Informal Dinner of Members of Council.

8.15 p.m.—Council Meeting.

All the functions on Tuesday will be held at the Talbot Hotel, Stourbridge.

Wednesday, March 19 :—

9 a.m.—Leave Talbot Hotel for visit to (a) The Glass Works of Messrs. Stevens and Williams, Ltd., Brierley Hill; and to (b) The Brierley Hill Institute to inspect the glassware recently presented.

12.45 p.m.—Luncheon, Talbot Hotel, Stourbridge.

2 p.m.—General Meeting, Talbot Hotel, Stourbridge.

SOCIETY OF PUBLIC ANALYSTS.

The next meeting of the Society will be held on Wednesday, April 2, at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1, at 8 p.m.

The following papers will be read :—

"The Detection and Identification of Alkaloids in the Saliva and Salivary Glands." By Prof. M. Eldin Bey, B.Sc.

"The Separation of Cadmium and Copper in Spelter and Zinc Ores by Internal Electrolysis." By Ella M. Collin, B.Sc., A.I.C.

"The Routine Detection of Nitrites in Milk." By A. F. Lerrgo, B.Sc., F.I.C.

"A Method for the Determination of Titanium as Phosphate." By J. C. Ghosh, D.Sc.

ROYAL INSTITUTION.

21, ALBERMARLE STREET, LONDON, W.1.

Friday, March 28, at 9 p.m.—"The Transmutation of Matter. Sir Ernest Rutherford, F.R.S.

Saturday, March 29, at 3 p.m.—"Atomic Nuclei and their Structure." Sir Ernest Rutherford, F.R.S.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

7,245.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of azo dyestuffs insoluble in water. March 5.

7,401.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of 2-imidazolone derivatives. March 6.

7,403.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of materials resistant to or free from nitro-organisms. March 6.

7,516.—I. G. Farbenindustrie Akt.-Ges.—Purification of resinous &c. products and hydrocarbons. March 7.

7,378.—I. G. Farbenindustrie Akt.-Ges.—Production of insoluble azo-dyestuffs on cellulose &c. March 6.

Specifications Published.

301,423.—I. G. Farbenindustrie Akt.-Ges.—Process for the manufacture of monoazo dyestuffs.

301,329—Durand & Hugueuin Akt.-Ges.—Manufacture of dyestuffs.

Abstract Published.

324,220.—Nitrogen oxides.—Johnson, J. Y., 47, Lincoln's Inn Fields, London. (Bergfeld, L., Heidelberg, Germany.).

Nitrogen oxides are absorbed from dilute gas mixtures, such as gases from the oxidatiodn of ammonia or from the arc process by treatment with aqueous solutions of compounds of hexavalent chromium or of manganese of a higher valency than two, such as potassium chromate or bichromate, calcium permanganate, manganic sulphate or phos-

phate, &c. The solution may also contain salts such as sodium or potassium nitrate, or acids such as phosphoric or arsenic acid. The absorption may be carried out at ordinary or raised temperature and at raised pressure. The solutions or the solid substances obtained by evaporation yield concentrated oxides of nitrogen on heating, and the residues may be oxidized and dissolved for use again.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ENGINITE.

499,448.—Chemical preparations for removing rust, scale and corrosion from the inside of motor radiators and engine jackets.—Perce Edwards, trading as Industrial Refining Co. 119, West 41st Street, New York City, New York, United States of America. March 12.

EUSMENOL.

509,984.—Chemical substances included in Class 1, for use in the dyeing industry.—H. Th. Bohme Akteingesellschaft, (a Joint Stock Company organised under the laws of Germany), 29, Moritzstrasse, Chemnitz, Saxony, Germany. March 12.

PRAEDIGEN.

509,985.—Chemical substances included in Class 1, for use in the dyeing industry.—H. Th. Bohme Aktiengesellschaft, (a joint Stock Company under the laws of Germany), 29, Moritzstrasse, Chemnitz, Saxony, Germany. March 12.

GERMINOL.

509,210.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—The firm trading as Germinol Products Company, 82, Becklow, Road, Shepherd's Bush, London, W.12. March 12.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. DRUCE.

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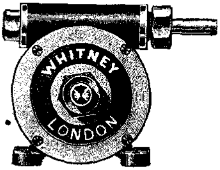

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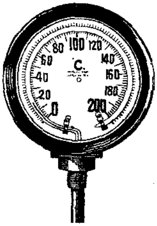

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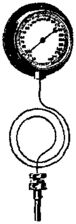

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LIGHT VELOCITY AND PLANCK'S CONSTANT; AND THE LACK OF AGREEMENT AMONGST LEADING CONSTANTS—A DILEMMA.

By F. H. Loring.

In the new physics, involving the principle of relativity, c becomes the limiting velocity. It is a constant that enters into many equations expressing physical phenomena. c may be regarded in several lights as follows :—

(1) *A spreading constant. A term* used frequently by the present writer—see for example *Chemical News*, 1928, *137*, 274-275.

(2) *A measure of the curvature of space* in which case *flat* space would make it infinite — *see* Light in Four Dimensional Space, J. Halero Johnston, *Nature*, 1930, *125*, 199-200.

(3) The physical equivalent of ∞ that is *not* mathematically infinite—a well-known idea.

(1), (2) *and* (3) *are consistent with one another.*

Considering now h in connection with this idea (particularly 2 and 3), physically it has the dimensions of energy multiplied by time; or, spectroscopically energy divided by frequency; but has it not also to be taken in conjunction with time in terms of distance ?

Now if c is a physico-mathematical infinity, is not h the quantity that makes a progressive four-fold ratio, so to speak, true? This can be illustrated as follows :— **1** : **2** : : **3** : **4**, very roughly of course. To make the proportional ratio closely exact larger values would have to be taken. **21** : **22** : : **23** : **24** for example is more nearly true. To have absolute proportional agreement in these values, differing progressively by unity (1, 2, 3, 4), they would have to be infinite; but light-velocity sets an inner limit, as it were, at 3×10^{10} cms. per second. If now the proportion is : $(3 \times 10^{10} + \mathbf{1})$: $(3 \times 10^{10} + \mathbf{2})$: : $(3 \times 10^{10} + \mathbf{3})$: $(3 \times 10^{10} + \mathbf{4})$ the error is very small indeed, namely, $0.000,000,000,0\dot{6}$.

It will be seen that the recurring figure is close to the left-hand value of h, 6.55×10^{-27}, neglecting the decimal place for the moment. *Making the velocity of light* 2.99796×10^{10}—the present-day value—does not appreciably alter the result, as it is still . . . 66 . . Converting 2.99796×10^{10} cms. into Angström units, and using **1, 2, 3, 4** Angströms respectively at the tails gives the value 6.671×10^{-19}.

From Bearden's wave-lengths h comes out at 6.629×10^{-27} (see article by A. H. Compton in the *Journal of the Franklin Institute*, November 1929, Vol. 208, pp. 605-616). In this case e is raised to the value : 4.810×10^{-10} and $e/m = 1.769 \times 10^{7}$ (= F. Wolf's value, corrected.)

Suppose, however, that the value for light is arbitarily changed to 4×10^{10}, the final value comes out at . . . 5 instead of . . . 667.

Now the value 3×10^{10}, the light-velocity, is not an isolated one as it is the ratio of the electrostatic to the electromagnetic units. Therefore " 3 " is fixed very closely. This being the case, the other value is fixed at . . . $\dot{6}$ very closely, with of course 10 noughts before it, that is to say, $6.\dot{6} \times 10^{-11}$; or, 6.671×10^{-19} when using the present value of c converted into Angström units. This means evidently that the velocity of light has to be carried into the decimal region far enough to give 6.67×10^{-27}; or, its value raised 10^{n}, times, when $n = 16$; that is to say, if the *idea can be carried further in the direction* suggested.

The *proportional equation can then be* written thus :—$(c \times 10^{16} + \mathbf{1} + h)$: $(c \times 10^{16} + \mathbf{2}) = (c \times 10^{16} + \mathbf{3})$: $(c \times 10^{16} + \mathbf{4})$, when $c = 3 \times 10^{10}$, $h = 6.\dot{6} \times 10^{-27}$. $hc \times 10^{16} = 2.\dot{0}$.

It will be seen that the balancing or ballast factor h, is virtually derivable from the *two extremes* : 3 . . . . . n, when n = **1,2,3,4,** taken progressively as shown.

From considerations arising out of wave mechanics, according to an interpretation of Eddington (*Proc. Roy. Soc.*, 1929, *A122*, 358-), $1/\alpha$ should be exactly 136, α being Sommerfeld's fine-structure constant. This means (using Birge's expression) that $1/\alpha = (h/e)(c/2\pi e) = 136$. As a result h should be 6.652×10^{-27}. This is nearly equal to 6.67×10^{-27}, the difference between the left-hand values being 0.018.

R. T. Birge's long article on the probable values of the general physical constants (*Phys. Rev. Sup.*, 1929 *1*, 1-73) though drawn up with great care does not support the higher values for h and e in particular. Birge's values are on the *decidedly low* side, *viz.* : $h = 6.547 \times 10^{-27}$ and $e = 4.770 \times 10^{-10}$. Yet Bearden's work (see above) *and the latest and best value for* e/m, *by* the deflection method, points to the higher values. There is, however, a possibility

that there should be a difference between the spectroscopic values and that obtained by deflection. So, too, there may be a difference between the more purely mathematical values and those derived more directly from experiment; but on the other hand it seems difficult to suggest an error in Bearden's precision determination sufficient to reconcile the lower values of Birge, as Compton has practically indicated in his article (*loc. cit.*) The following table from this article shows the present state of affairs very clearly.

Constant.	From Bearden's wave-lengths.	Accepted Values (Birge.)	Per cent. Differences.
D Calcite.	3.0367A.	3.0283A.	0.3
N	6.014×10^{23}	6.064×10^{23}	0.8
e	4.810×10^{-10}	4.770×10^{-10}	0.8
h	6.629×10^{-27}	6.547×10^{-27}	1.2
e/m	1.769×10^{7}	1.769 (deflection)	0.0
		1.761. (spectrum)	0.5

It will be remembered that the present writer evolved h from c and R_∞ by means of the equation :— $R_\infty/(24 \times 10^{-33}/h) = 299796$ kms. per sec., when $R_\infty = 109737.37$, $h = 6.556 \times 10^{-27}$. See *Chemical News* cited above. Birge (*loc. cit.*) gives Houston's precision value for R_∞ 109737.42 ± 0.06.

Commenting on the above, it would appear that some unforeseen constant enters into these calculations, for it must be remembered that using the constant R_∞ brings about values otherwise in agreement by formulæ, but not in agreement with e and h as demanded by Eddington's "136" as above (*i.e.*, $hc/2\pi e^2 = 136.0$), or as demanded by the wave-length lines of copper obtained by using ruled gratings of 50 and 600 lines per millimetre as described in Bearden's paper (*Proc. Nat. Acad. Sci.* 1929, *15*, 528-533). These wave-length lines are the X-ray K lines, this being the work referred to above, which is of very high precision.

In any case we appear to be faced with a dilemma. Is there another small cloud appearing on the horizon? Will we have to work with two sorts of units, just as on certain days of the week the undulatory theory of light is used while on other days the quantum theory is the appropriate one, to state it very much as Bragg has done for the radiation dilemma.

It is to be noted that the "3" used above, in connection with its proper multiplier, is not regarded as the truer value, as the velocity of light is now very accurately known, which is given above. 3 was merely used to simplify the calculation in certain cases; but of course the introduction of two sets of units differing slightly from each other might involve two values of c. More experiment is needed before much can be said in this respect, however.

For discussions of errors and proposed corrections in the grating constant resulting from Bearden's work and that of others, the following literature in addition to papers referred to above may be consulted :

A. W. Porter, *Phil. Mag.*, 1928, *5*, 106.
E. Bäcklin, *Inaug. Diss. Uppsala Universitets Arsskrift*, 1928; *Nature*, 1930, *125*, 239.
J. A. Prins, *Nature*, 1929, *124*, 370.
S. Fagerberg, *Nature*, 1930, *125*, 13.

Since writing the above it is of interest to note that Eddington now gives the value as 137, instead of 136, in a long paper in the *Proceedings of the Royal Society*, 1930, *A126*, 696-728.

In the opening part Professor Eddington says :—

"According to II [Eddington, *Proc. Roy. Soc.*, 1928, *121*, 524; 1929, *II 122*, 358] the value of $hc/2\pi e^2$ was 136. I remarked that, as it represented the number of degrees of freedom of a system, small mistakes were unlikely; nevertheless I appear to have made such a mistake, and the new prediction is 137. The 136 symmetrical degrees of freedom are a generalisation of rotations and translations in space; but it is characteristic of a pair of electrons that they possess one special degree of freedom unlike the others which has no analogue in the theory of a single electron, *viz.*, an alteration of the proper distance between them; and whereas the 136 rotations are relative to the frame of reference employed, the odd deg

freedom represents alteration of an absolute *quantity (the interval). The mistake in the* earlier theory was not so much in overlooking this degree of freedom (for it there *appeared as the rotation which* 'interchanges the identity of the two electrons') as in not recognising its distinctness from the others. No one of the 136 relativity transformations can play the part of this non-relativity or gauge transformation."

As interesting as these speculations are experiment must decide the matter obviously.

Referring to the main idea of this paper, it should be noted that the scheme involves *ratios, c being one as explained above*, while *h* enters into another which makes up practically a whole-number ratio in a four-fold proportional equation involving numbers **1, 2, 3, 4.**

For articles in this Journal bearing on the Physical Constants see—1928, *136*, 145-147, 161-165; *137*, 274-275, 370; 1929, *138*, 18-22, 81, 228-229, 242-243, 305-306; *139*, 129-133.

Those interested in the peculiarities of *numbers in connection with the above* should note that the *absolute* value within the round brackets in the proportional *equation, top of eleventh paragraph*, is—

$$3 \times 10^{26} + 1 + 0.0_{26}6_{25}5_{1}7 \text{ to infinity}$$

The inferior numbers (printers' notation), or numerical subscripts, denote here the number of noughts, sixes, etc., in the decimal fraction. A dot over a nought, or over any number, means that it repeats indefinitely for all practical purposes. 7 to infinity is equal to 7 with a dot over it.

The numbers **1, 2, 3, 4** when multiplied together give 24. Their sum is 10.

1
2
4
8
16
32
64
128 &c.

124999 . . . × 24 = 299999. . . .

MATTER AND LOGIC.

By Dr. W. Tombrock.

The Ether of Mendeléeff. III.

Series	*Zero Group*	*Group I*	*Group II*
0	x		
1	y	Hydrogen H = 1.008	
2	Helium He = 4.0	Lithium Li = 7.03	Beryllium Be = 9.1

As may be seen from the above corner of Mendeléeff's periodic system, y and x are *unknown extrapolated* elements. The postulation of these is due to the well-known Russian chemist himself (*loc. cit.* p.26).

He was aware of the somewhat speculative nature of such an extrapolation; his excuse why he nevertheless published this conception typifies the man as a classical representative of science :

"My reason for doing this was determined by two considerations. In the first place, I think I have not many years for delay (Mendeléeff was 68 when he wrote this and died 8 years later); and in the second place, in recent years there has been much talk about the division of atoms into more minute electrons, and it seems to me that *such ideas are not so much metaphysical as metachemical*, proceeding from the absence of any definite notions upon the chemism of ether, and it is my desire to replace such vague ideas by a more real notion of the chemical nature of the ether." (*loc. cit.* p.17).

To what values in quantatively recorded *properties did Mendeléeff arrive now for* these extrapolated elements?

They belong qualitatively to the zero group, to helium, neon, argon, krypton and xenon, the chemically inert, rare gases.

He calculated for y, which the thought of as "coronium or some other gas" (*loc. cit.* p.30) an atomic weight of "0.4 and probably less." The molecular velocity of translation would be about 2.24 times as large as that of hydrogen. This element "cannot possibly be ether, its density being too great" (*loc. cit.* p.30). Only x can then be considered as ether, for the values of the molecular velocity and atomic weight of which he finds the following figures : (*loc. cit.* p.42).

"it seems to me that the velocity of the particles of our gas (ether) must, in order to permeate space, be greater than 2,224,000 meters a second and probably less than 300,000,000 meters a second.

Hence the atomic weight of x as the lightest elementary gas, permeating space and performing the part of ether, must be within the limits of 0,000.000.96 and 0,000.000.000.053, if that of H = 1."

Mendeléeff's remark on this is of importance : (*loc. cit.* p.43) "I think it is impossible, under the conditions of our scientific knowledge (1902), to admit the latter value, because it would in some measure answer to

a revival of the emission theory of light, and I consider that the majority of phenomena are sufficiently explained by the fact that *the particles and atoms of the lightest element x capable of moving freely everywhere throughout the universe have an atomic weight nearly one millionth that of hydrogen, and travel with a velocity of about 2,250 kilometers a second.*"

Mendeléeff wrote this in 1902. He thus expected the discovery of two new elements as argon and the other inactive gases were discovered, or in any case assumed the possibility of their existence. He considered these elements, although of lower atomic weight than H, as fitting completely into his system and must thus have also implicitly assumed a spectrum for these elements.

We now write in 1930. Thus more than a quarter of a century later. No new elements have been discovered which could be put in the place of x and y. No new elements at any rate in the complete chemical sense of the word with, as we now say, a complex chemical atom, consisting of several particles, no new elements which reveal themselves through their spectrum. But now, just as previously, empirical induction and common sense demand the ether-particle and what is more we have come to know the electron experimentally. Naturally. . . a spectrum is lacking in the logically demanded ether-particle, given the all-pervading nature of the ether, even in the atom itself, its spectrum, assuming that the ether had a spectrum, must have been revealed long ago. . . but also the electron has, as far as I know, no independent, characteristic observable spectrum. To this extent Mendeléeff was in error or at any rate his hypothesis received no confirmation; no new, true chemical elements with a spectrum and complex atoms were discovered for y and x.

But there is one factor about which Mendeléeff did *not* reflect or at least did *not* seriously take into consideration, which in view of the state of science in his time (1902) could indeed hardly have been taken into account: *the difference between a true chemical complex atom and the simple, or shall we say Democritian atom.*

As concerns *our* standpoint now; the least hypothetical explanation of nature after our chemical routine of thought, or if you will the principle of the simplest hypothesis compel us to consider the electron as simple—it is possibly already experimentally recognised as simple also—*we* now consider the electron as a larger, simple rotating particle with a considerable translational velocity. We conceive the ether particle as also simple but much smaller and quicker still. The protons—which incidentally Mendeléeff did not wish to assume as structural units of matter—have meanwhile also found experimental recognition. We consider these as complex. . . .

In this connection the question forces itself upon our notice: will the jump here assumed from complex "true" chemical atom to simple (Democritean) atom bring about a considerable difference in properties, or not?

Would thereby perhaps not only the spectrum disappear but with it also the mass effect be considerably reduced, the translational velocity considerably increased?

Would Mendeléef *then* have really been right "after all"?

There remains noteworthy in any case the coincidence that Mendeléeff had to extrapolate *two* elements x and y and we now work with *two* material particles very different in size, the ether-particle and the electron.

Let us make a *resumé* final of what we could note down in our three successive articles on Mendeléeff's ether:

The supposition of Mendeléeff then that the ether can be a gas finds its echo in an article written 24 years later by Sir J. J. Thomson, who in his "The Mechanism of the Electric Field," thinks of a subatomic, subelectronic gas.

The conception of Mendeléeff on matter is that of complete discontinuity. (I).

Mendeléeff subsequently demonstrates that an objection from the chemical side against the material ether has been removed by the discovery of the rare chemically inert gases by Ramsay and his collaborators. The idea then that the ether could be "primary matter" for other elements was not acceptable to Mendeléeff because then, in his opinion, the ether would also have to possess noticeably the general properties of matter. This objection, however, becomes void when one considers that more complicated properties of matter first occur in a more complicated composition of the matter. The ether can thus very well be "primary matter," if we assume that it consists of simple—Democritian—atoms (II).

Finally in (III)—*we can, taking a favourable view, see in Mendeléeff's conception a foreshadowing of the electron and our Democritian ether atoms.*

Bergen op Zoom,
Holland.
February, 1930.

INDUSTRIAL PULVERISED FUEL FIRING.

SOME IMPORTANT BRITISH INSTALLATIONS.

By A WELL-KNOWN ENGINEER.

More than 100 years ago in France Niepce, associated with Daguerre, of photographic fame, studied the combustion of coal in the pulverised condition, while in 1868-1870, Thomas Russell Crampton, of London, burnt over 2,000 tons of pulverised coal. However, it is only recently this method has been adopted upon an extensive scale, and one of the outstanding advances in steam and power practice is "Lopulco" pulverised fuel firing, which originated in 1920 at the Lakeside Station, Milwaukee, and was first adopted in Great Britain for electricity station working in 1924. Even more striking is the application to industry, in which connection water tube boilers, high steam pressures, and generating of electricity by "pass-out" turbines are now regularly employed. Also at the present time the following industrial boiler plants with "Lopulco" pulverised fuel firing are operating, or in course of erection, in Great Britain and others are under active consideration :—

Stewart and Lloyds, Ltd. (Coatbridge); York Spinning Co., Ltd. (Belfast); Synthetic Ammonia and Nitrates, Ltd. (Billingham) three separate contracts; Ashington Coal Co., Ltd. (Durham); Pilkington Bros., Ltd. (St. Helens); Shell-Mex, Ltd. (Shellhaven, Essex); Metropolitan Carriage and Wagon Finance Co., Ltd. (Birmingham); Taylor Bros., Ltd. (Manchester); and the Bolsover Colliery, Ltd. (Yorkshire).

Messrs. International Combustion, Ltd., since 1924 have also equipped 14 British power stations with pulverised fuel firing, that is, Brimsdown (London); Nechells and Mams Hall (Birmingham); Derby; Willesden (London); St. Pancras (London); Poplar (London); Walsall; Kirkstall (Leeds); Leicester; Neasden (London); Barking (London); Brighton, and Scarborough. Further, they installed "Lopulco" pulverised fuel firing equipment (from England) on a number of power stations abroad, such as Congella (Durban); Buenos Aires (Argentine); Shanghai, Perak Hydro-Electric (Malay States); Rosario (Argentine); and The Hague (Holland). For large and medium-sized industrial installations, especially when using a large amount of process and "boiling" steam, the ideal practice is high pressure water tube boilers and pass-out turbines, generating electricity and providing all the necessary low pressure steam from the turbines, thus avoiding the latent heat of steam loss. The latest principles of "Lopulco" pulverised fuel firing include the new "R" turbulent short flame burner, fixed horizontally at the front of the setting, smaller combustion chambers, air heating, hot air passed through the "Raymond" centrifugal pulverisers, and all the air for combustion going through the burners only, water screen, and two side walls in series with the boiler. Under these conditions 88-90 per cent. steam generation efficiency is obtained in actual continuous running all the year round, with of course absolutely smokeless combustion and 93-94 per cent. on 12 hours trials, although 55-60 per cent. is about the present average industrial steam generation efficiency and, say, 70-75 per cent. for power stations.

MEINICKE CLARIFICATION REACTION FOR SYPHILIS (M.K.R.)

The comparative serodiagnostic tests for syphilis carried out at the last International Serological Conference (Copenhagen, June, 1928) showed that the Wassermann, Sigma, S.G.R., and other reactions for syphilis (excepting only the methods of Kahn and Muelles) are not sufficiently sensitive. The Kahn and Mueller tests, moreover, require special apparatus, and cannot, therefore, be carried out at every laboratory.

In view of these facts, the new Meinicke Clarification Reaction (M.K.R.) deserves every attention as a particularly simple, reliable and sensitive test, easily executed and easily read. A considerable amount of confirmatory literature already exists.

Dr. Meinicke has quite recently been presented with the "George Speyer Haus—Ludwig-Darmstadt Prize and Paul Ehrlich Diploma" for his serodiagnostic work in syphilis.

Gratis quantities of Meinicke's original standardised Tolu-Antigen, the fundamental for the test in question, can be obtained from the London Depot, W. Bredt, 38, Gt. Tower Street, E.C.3.

SHIPPING AT BRITISH PORTS IN 1929.

Our annual review of the movement of shipping at United Kingdom ports shows all-round increases for last year as compared with 1928 in the foreign trade. Those in the entrances in ballast and the clearances with cargo were due mainly to larger coal exports. The British proportion of the total net tonnage rose 3 per cent., Swedish 21.6 per cent., and Norwegian 11.6 per cent. The coasting trade was 6.4 per cent. greater than in 1928.

BREWING AS A BRANCH OF SCIENCE.

By Professor Arthur R. Ling, M.Sc., F.I.C

Paper read before the Royal Society of Arts, March 5th. Sir William Waters Butler, Bt., F.C.S., Past-president of the Institute of Brewing, presiding.

Brewing is an industry of great antiquity, and like other industries it was at first an empirical art, its sole guidance throughout the ages being the experience handed down from generation to generation. Indeed, systematized knowledge, which we know as science, as applied to brewing, was unknown 60 years ago, and even since then what has passed as science has ofteu been shrouded in superstition.

The manufacture of beer from barley is mentioned in the Westcar Papyrus. The Egyptians obtained their knowledge of brewing from the Babylonians who brewed beer in 7,000 B.C. From the earliest times it would appear that there was a close connection between brewing and agriculture, and with the cultivation of barley and wheat, since bread and beer depend on grain and yeast for their manufacture, the bakers were in the early days also brewers. Indeed it is known that the bakers of ancient Egypt and Babylon were also brewers.

Although the application of science to brewing is comparatively recent, attempts to explain some of the phenomena connected with fermentation are to be found in early scientific writings. Of the views of the ancients on fermentation we have but few records. In Pliny's "Natural History" the fermentation of dough in bread making is supposed to be effected by a sour substance. Passing to the period of the alchemists (350-1577 A.D.) and of the iatrochemists (1577-1644 A.D.), allusions are frequently made to fermentation, and it is interesting to note that the term fermentation is as a rule employed indiscriminately with the terms digestion and putrefaction, all three of which are known to be associated with the activity of agents which we now call enzymes.

The brewer is closely connected with living processes—in the barley field, in malt house, and brewery. The changes occurring during the life of an organism known as metabolism are the result of the activity of those agents still denoted ferments but more usually referred to as enzymes. Our knowledge of these agents and of the changes which they induce has been gathered more from the work of those who have studied the fermentation industries than from any other source.

Modern history of fermentation commenced with the observation of Kirschoff in 1814 that the so-called gluten of wheat flour is capable of converting starch into sugar and dextrin. Following this was the work of Payen and Persoz, who isolated from barley malt the substance known as diastase.

A chemical epoch commenced with the theory of fermentation propounded by Liebig in 1839. It postulated a ferment as a substance in a kinetic state capable of imparting motion to the substrate with which it was in contact, and hence decomposition of the latter ensued.

Yeast was examined under the microscope by Leeuwenhoek in 1680, who recognised its cellular structure. The biological epoch of alcoholic fermentation commenced with the work of Schwann (1836-37) who showed experimentally that the phenomenon was due to the presence of living organisms. The vitalistic theory of fermentation was however finally established by the brilliant work of Pasteur. The fact that yeast had been proved to he a living organism was to Liebig a matter of indifference; he considered its multiplication to be in no way connected with the process of fermentation. In his last paper on the subject in 1870, however, Liebig modified his theorv and at the same time made considerable concessions. He now put forward the view that during the life of yeast, there is produced, in the interior of the cell, a ferment and it was to this that the phenomenon of fermentation was due. To this Pasteur replied "*Ici je ne contradis encore pas.*" Pasteur states however that during his work he had constantly sought in vain for a ferment (enzyme) which could act independently of the yeast in its living state. It was the discovery of an enzyme by E. Buchner in 1897 that marks the biochemical epoch. Buchner, by submitting yeast to a pressure of someth'ng like 10 tons to the square inch succeeded in expressing a liquid which was rendered free from living cells by filtration through a Pasteur-Chamberland filter. This liquid contained the active enzyme (zymase) capable of converting sugar into carbon dioxide and alcohol. Buchner's discovery thus united the chemical theory of Liebig in its latest form and the vitalistic theory of Pasteur. Buchner's observations have been confirmed by numerous other workers, and it may be said that the greatest additions to our knowledge of the subject have been made by Professor Arthur Harden and his school.

The brewer was one of th efirst to harness an enzyme to his service. This he did at

first unwittingly, but subsequently (those among his ranks such as C. O'Sullivan and Horace T. Brown studied the problem from the standpoint of pure science, and by their studies laid the foundation of our present precise knowledge. Even at the present time the problem of the true nature of an enzyme if far from settled. So far as our knowledge extends it is a substance or mixture of substances capable of inducing a reaction by its presence without itself undergoing any change. In other words it is a catalyser analogous to those inorganic catalysers investigated by Faraday, Mitscherlich, Berzelius and others in the early years of the last century. Many active preparations of enzymes contain proteins but cases are known of enzyme preparations which do not contain a protein, e.g. invertase of yeast.. An active enzyme is invariably in the colloidal condition, and it is an amphoteric electrolyte, i.e., it exhibits the phenomenon of kataphoresis as shown by the work of Professor Michelis. We owe to Professor Wilstatter researches embodied in some 130 papers describing attempts to purify enzyme preparations by making use of their electro-positive or electro-negative properties as first indicated by the work of Michaelis. Thus some enzymes are adsorbed by electro-negative kaolin, whilst others by electro-positive alumina. From the adsorbent the enzyme may be liberated by elution with dilute alkalis, phosphates, etc. Some enzymes after having been purified to some extent by the adsorption-elution process apparently change their sign. Thus crude invertase is adsorbed by alumina, but not by kaolin. Despite the immense amount of work carried out this great chemist has not succeeded in isolatin an active enzyme preparation consisting of a single chemical substance. Just as enzymes are adsorbed by certain inorganic substances, so it would seem that some sort of combination—adsorption—with the substrate precedes the re actions which they promote. Thus Emil Fischer, found that α-glucoside was hydrolised by maltase and β-glucoside by emulsin. He was led to assume that a relationship exists between the structure of enzymes and substrate, that enzymes had specific properties, and combination of enzyme and substrate precedes the final change. Wilstätter considers that enzymes are composed of a colloidal bearer and a specific active group, whih enables them to be bound to the substrate, and the composition of which at the same time conditions the colloidal nature of the entire complex. This is tantamount to the view I have long held and expressed elsewhere on several occasions, that an active enzyme constitutes a system rather than an individual. Such a conception enables us to understand Harden's well-known discovery that zymase of yeast may be separated into two portions by ultrafiltration, both of which are inactive, unlike the parent mixture. When they are reunited activity appears. The portion passing through the filter is called by Harden the co-enzyme. It may be boiled without losing its activating power. The colloidal portion which does not pass through the filter is the zymogen. After heating it is no longer activated by the co-enzyme.

Bearing in mind the fact that starch constitutes the principal constituent of malt, it is not surprising that several of the leading scientific men connected with the brewing industry have taken up its study. The problem still awaiting solution is the structure of the starch unit, and the obvious course of attack is to ascertain the nature and quantity of the substances formed when the complex starch molecule is broken down into simpler substances which may be assumed to be the bricks of which the starch itself is built. When starch is treated with dilute acids it is converted into glucose. this has not so much significance as the nature of the products resulting from the action of the amylase (diastase) of malt (which is one of the active agents operating in the mash tun) on starch.

(*To be continued.*)

CHARLES MAYER WETHERILL
(1825-71).

(PROF. E. F. SMITH'S LAST BIOGRAPHY).

The interesting biography of Dr. C. M. Wetherill, a distinguished American analytical practitioner and professor of chemistry was the last work from the pen of the late Professor Edgar Fahs Smith of Philadelphia. At the time of Professor Smith's death the manuscript lacked certain letters which were expected on the return of Dr. R. B. Wetherill from Europe and the biography was finally completed by Professor C. A. Browne.

C. M. Wetherill was descended from early Quaker settlers in Philadelphia and as a boy he was early distinguished b his studious nature. After obtaining an Arts degree at Pennsylvania University he took an interest in practical chemistry in the lagoratory of Booth and Boye. From there he went, in 1846, to France and Germany to study especially under Pelouze and Liebig, both of whom wrote highly of him and gave him an insight into the methods of chemical anlysis.

On returning to America, Wetherill opened up an analytical practice and en-

gaged himself in research work on varied subjects, especially minerals. His analytical ability seems to have been in advance of his American contemporaries and he expressed himself very clearly and openly. His results, even with the poor equipment often at his service were remarkably accurate and have not necessitated any substantial alteration since his time.

Professor Smith relates Wetherill's services in connection with the New York Exposition of 1854. This was followed by a period of travel during which he met his wife and he then settled for a time at Lafayette in Indiana. Here he devoted his attention to local industrial matters where his scientific knowledge was of service. He wrote a book on the "Manufacture of Vinegar" with special reference to the "Quick Process" and an insight is given to the publishing practice of those days.

In 1862 Wetherill was appointed Agricultural Chemist by President Lincoln who later engaged him in the analysis of a secret powder to replace gunpowder. Difficulties with his chief at the Ministry of Agriculture led to his dismissal but he soon obtained a post at the Smithsonian Institute for two years prior to his period as a professor of chemistry at Lehigh University. After giving several tributes to Wetherill's good qualities Professor Smith concludes "He was one of those 'golden natures' who help us form ideals of life." To this Professor Browne, in editing the manuscript for press has added, "This final sentence—in pencil—are the last words of the biography. It is also the terminus of (Professor Smith's) long literary activities as a contributor to the science and history of chemistry. The thought expressed in this valedictory statement applies so perfectly to Edgar Fahs Smith himself that it might well be inscribed in letters of gold above the entrance to his office."—*J.G.F.D.*

FOREIGN BITUMEN IMPORTS.

Figures Increasing.

According to the Board of Trade Returns issued during March, 13,565 tons of foreign bitumen were imported into this country during February. This is an increase of over 500 tons on the figures for January and brings this country's expenditure for bitumen during the first two months of 1930 up to £126,052.

In addition to these imports, large quantities of bitumen are distilled annually in this country by foreign oil companies from imported petroleum in the process of manufacturing lubricating oils and petrol and are used on British roads instead of British materials such as tar.

GENERAL NOTES.

DIATOMITE DEPOSITS IN CANADA.

Diatomite is a light, fluffy material composed of the minute skeletons of diatoms, and is used in industry as an insulator against heat and sound, for filtering, and as an ad-mixture in concretes and plasters.

As an insulator against heat diatomite is one of the few materials that will effectively withstand very high temperatures, and its field of application ranges from household furnaces, water pipes, boilers, etc., to furnaces used in the steel and smelting industries. It can be conveniently moulded into pipe covering, slabs and bricks. Diatomite has few equals for sound insulatiou and has the advantage of being fireproof. Diatomite is also recognised as one of the best known media for accomplishing rapid and clear filtration. Sugar refining is at present the largest individual industry using diatomite for this purpose. In concrete diatomite retards the settling of the solids in the wet mixture during handling, or transportation, by reason of its high absorptive properties.

Canada has a large number of deposits in British Columbia, Ontario, and in the Maritime Provinces, from which diatomite suitable for almost every known use can be obtained. Report No. 691 of the Mines Branch of the Dominion Department of Mines, Ottawa, records the results of an investigation into the sources and uses of diatomite in Canada. Copies of this Report can be obtained by persons interested either from the Mines Branch at Ottawa or from the Acting High Commissioner for Canada, The Canadian Building, Trafalgar Square, London, S.W.1.

WITHHOLDING GOODS.

Board of Trade Announcement.

The Lord Chancellor and the President of the Board of Trade have appointed a Committee to consider present trade practices which result in withholding from particular retail traders supplies of goods in which they wish to deal or which prevent the resale of such supplies except upon conditions imposed by the suppliers, and to report whether in their opinion all or any of such practices are detrimental to the public interest, and, if so, what alterations in the existing law are necessary to prevent this continuance of such practices. The membership of the Committee is as follows :—

Wilfred A. Greene, Esq., K.C. (Chairman); Alexander Johnston, Esq., J.P.;

Professor D. H. Macgregor, M.C.; W. E. Mortimer, Esq.; J. E. Singleton, Esq., K.C.; A. G. Walkden, Esq., M.P.

The Secretary of the Committee, to whom all correspondence should be addressed, is Mr. C. K. Hobson, M.B.E., Board of Trade, Great George Street, S.W.1.

WORLD CONSUMPTION OF COPPER.

World consumption of copper in 1929 was estimated by the American Bureau of Metal Statistics as 2,000,000 tons. This shows no change from 1928 and is especially significant in view of the high prices which prevailed during the year. Consumption in the United States increased 13 per cent. and amounted to 1,100,000 tons, but in other parts of the world it decreased from 1,000,000 tons to 900,000 tons. Europe imported nearly 88,000 tons less from North and South America. This decrease was largely due to expansion in the refining capacity of Germany and Belgium, where African ores are treated.

In spite of the increased consumption in the United States, the stock of refined copper in North and South America amounted to 170,000 tons at the end of 1929 as compared with 65,000 tons at the end of 1928. This increase in available stock places the industry in a much more comfortable position, and would enable it to meet any unforeseen demand. The rapid expansion in the utilization of copper has changed the significance of any given level of supplies. At the present rate of consumption, less than two month's requirements were on hand at the end of 1929. Available figures show that the yearly per capita consumption of copper in the United States has increased from 8.49 lb., in 1921 to more than 17 lb., in 1929.

MARKET FOR SULPHATE OF COPPER IN ALGERIA.

A confidential report on the market for sulphate of copper in Algeria has been prepared by the Department of Overseas Trade from information furnished by His Majesty's Consul-General at Algiers and issued to firms whose names are entered on its Special Register.

United Kingdom firms desirous of receiving a copy of this report together with particulars of the Special Register service of information and form of application for registration should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Thursday, March 20.

The Mechanism of, and Constitutional Factors Controlling, the Hydrolysis of Carboxylic Esters. Part I. The Constitutional Significance of Hydrolytic Stability Maxima. By C. K. Ingold.

An outline is given of a method for the analysis of constitutional effects on ester hydrolysis. It is shown that the data which locate hydrolytic stability maxima are more simply related to constitution than are hydrolytic velocity coefficients, and that the former afford a means of separating polar from superimposed polar and steric influences. The matter is illustrated by reference to the data which are available for the purpose.

Part II. Hydrolytic Stability Maxima of Glyceric Esters. By C. M. Groocock, C. K. Ingold, and A. Jackson.

Data are given permitting the location of the hydrolytic stability maxima of eight esters of glyceric acid, on the basis of experiments designed to eliminate from the results both contributory catalysis by buffer constituents and effects due to buffer ion environment on catalytic activity.

10-Chloro-5 : 10-Dihydrophenarsazine and its Derivatives. Part XIII. Absorption Spectra. By C. S. Gibson, E. S. Hiscocks, J. D. A. Johnson, and J. Ll. Jones.

THE PHYSICAL SOCIETY.

February 28.

A New Type of Dewar Flask for use as a Calorimeter. By W. L. Watton, B.Sc., A.R.C.S., D.I.C.

The water equivalent of a new type of Dewar flash. of which the inside was of copper, has been measured at laboratory temperatures, and found to be more constant than the usual tpye. The precautions necessary in using such a calorimeter were fully discussed.

Field Intensity Measurements Around Some Australian Broadcast Stations. By R. O. Cherry, M.Sc., Natural Philosophy Laboratory, University of Melbourne.

The field intensities of wireless transmitting stations have been measured in order to determine some of the factors controlling the propagation of electro-magnetic waves, and the effect of the surface conditions on their attenuation. A simple loop, condenser and valve voltmeter circuit has been em-

ployed and careful tests show that this method is available for the measurements of intensities as low as 1 millivolt/meter. The grid-rectification voltmeter described is found to measure e.m.f.'s down to 0.01 volt, to be free from frequency error, reasonably stable in calibration, and not to absorb power from the circuit to which it is connected—the last fact being contrary to current theory. The advantages of this intensity set, which agrees over a wide range of field-intensities with a Western Electric set, in respect to simplicity, convenience and portability, are pointed out.

The field strength contours of three broadcast stations have been determined. From these the following conclusions have been drawn: (i) Very rapid attenuation of the signal is caused by Australian forest areas; this curtails enormously the areas for which a satisfactory service is provided. (ii) The effective conductivity of the various types of ground surface met with varies from 4×10^{-13} to 0.07×10^{-13} e.m.u., according to the number of trees in the areas covered. (iii) The use of a longer wave-length gives a marked increase of intensity at distant points beyond forest areas. (iv) For daylight transmission over sea water up to a distance of 85 miles, after the application of curvature-corrections to the intensity, Sommerfeld's formula is correct, to within the limits of experimental error. (v) The efficiency of radiation of the three aerials examined ranges from 48 to 60 per cent.

Finally, the limits of signal intensity required for satisfactory reception under Australian conditions are discussed, and it is suggested that atmospherics and other disturbances are less prevalent in Victoria than in Europe or America.

The Equations of Motion of a Viscous Fluid in Tensor Notation. By C. N. H. LOCK, M.A.

An outline of the tensor calculus for three dimensions is given, and an attempt is made to develop the theory of the motion of a fluid, by tensor methods, as far as the general equation of viscous flow.

MINERALOGICAL SOCIETY.

March 18.

Dr. G. T. Prior, President, in the chair. Professor W. L. BRAGG, O.B.E., M.A., F.R.S. (Professor of Physics in the University of Manchester), delivered a lecture on the Structure of Silicates. Illustrating the lecture by models and diagrams he demonstrated the principal results so far achieved by his investigations of the structure of silicate minerals by means of x-rays.

THE OPTICAL SOCIETY.

A meeting of the Optical Society was held at 7.30 p.m. on Thursday, March 13th, 1930, at the Imperial College of Science and Technology, South Kensington. The president, Dr. F. Twyman, F.R.S., in the chair.

The following papers were presented and discussed:—

Imagery around a Skew Ray. By T. SMITH, M.A., of the National Physical Laboratory.

The one-one corespondence between rays in the object and image spaces of an optical instrument only yields a corresponding relation between points, even for a narrow ray pencil, in exceptional circumstances. The usual criterion by which conjugate points are defined fails unless the neighbouring rays intersect in both spaces. In general this condition is not satisfied, and the criterion is therefore extended to include the points of nearest approach of non-intersecting rays. It is shown that pairs of conjugate points on a given chief ray determined according to this definition are coincident for a fan of near rays with one degree of freedom, that is the light path between the conjugate points is constant to the second after for the routes corresponding to all rays of this fan, and that the enlarged definition is applicable to all near rays. The relation connecting conjugate points is of the same form as for the simpler cases generally recognised, and may be determined by parallel projection through fixed points depending on the chief ray and on the particular fan under consideration. Apart from the exceptional case of complete anastigmatism due to the coincidence of the projective centres for all the fans, there can be at most two pairs of conjugative points free from astigmatism. Three conditions must be satisfied for stigmatic imagery at a given pair of points.

The pencil around any skew ray has ten degrees of freedom, and the fundamental co-efficients which determine the imagery completely are elements of a square matrix of the fourth order. Formulae are given for the construction of these matrices for refraction at each surface and for the transference from one surface to another. The matrix for the complete system is the product of the matrix factors for the successive elementary events taken in their proper order. Each refracting surface may be replaced by the osculating surface of the second degree at the point of refraction of the chief ray. It is assumed that the curvature of the surfaces is everywhere finite and continuous.

A more natural matrix for refraction in space of three dimensions would be of the sixth order. Such matrices are derived

om those of the fourth order. For theorical in vestigations and perhaps also for utine numerical work, these matrices are eferable to those of lower order since they ntain no quantities which are not relevant the problem. The coefficient of the eikal and of the characteristic function can derived from the elements of either type matrix. Fifteen independent relations tween the coefficients of these matrices are tained in two distinct forms.

Dr. R. A. Sampson, Captain T. Y. Baker, r. Perry, Mr. Bracey, Mr. Hasselkus and r. Twyman took part in the discussion and r. Smith replied.

The Purpose and Design of the New quipment at the Royal Observatory, linburgh. By Professor R. A. Sampson, .D., F.R.S.

The author dealt with the reasons which termined the form of the telescope—a Casgrain reflector of 36 inches aperture and feet focal length, serving a spectograph one, two or three prisms—and proceeded indicate the problems to which it was inded to apply it. These are, generally, e intensity of stella light for different parts the spectrum. It was pointed out that en an empiric treatment of this question d led Adams to a method that had doubled r knowledge of stellar distances. A theorical treatment, comprising a discussion of e behaviour of the photographic plate, had d to fixing the temperature sequence. A it spectograph was required in order to deal ith the lines. The state of the lines, commed with that of the continuous spectrum, onveyed all the information that reaches us f the star's constitution and atmosphere. ubsidiary but highly interesting questions ere those of selective absorption of light by e atmosphere of the Earth. Behind these as the theoretical and laboratory investiation of the relation between intensity of ght and the density of silver deposit on the hotographic plate. The whole presented n attractive field.

Mr. Coutts, Mr. Maurice Blood, Dr. Moore Ir. Guild, Mr. T. Smith, Dr. Perfect and Dr. Twyman took part in the discussion and Dr. Sampson replied.

A Description of the Stellar Spectroscope or the 36" Reflector at the Royal Observaory, Edinburgh. By Messrs. Adam Hilger Ltd.

Mr. J. H. Dowell described the one, two or three prism spectograph which follows closely in design that of the Dominion Observatory, Vancouver.

A Description of the 36" Reflector at the Royal Observatory, Edinburgh. By Messrs Sir Howard Grubb and Parsons, Ltd.

Mr. C. Young described the construction and method of manufacture of the Reflector by the aid of numerous lantern slides.

The optical system consists of two parts :

(a) The great parabolic mirror of 37 inches in diameter by 6 inches thick with a central hole 3½ inches in diameter and focal length 15 feet (F/5).

(b) The secondary or Cassegrain mirror of hyperbolic section, 10 inches diameter. With the main mirror the equivalent focal length is 54 feet (F/18). The reflected rays pass through the hole in the big mirror and are brought to a focus 22 inches behind its front surface. Three eye pieces are provided giving magnifications of 200, 400 and 600.

THE INSTITUTE OF METALS.

Twenty-second Annual General Meeting, March 12th and 13th.

At the twenty-second annual general meeting of the Institute of Metals held in London on March 12th and 13th, the retiring President, Dr. W. Rosenhain, F.R.S., inducted the incoming President, Dr. R. Seligman, into the Chair. The Secretary presented the Report of Council for the past year.

Report of Council.

The Council, reporting upon the past year's work of the Institute of Metals, stated that the year had been notable for some incidents of special interest in the history of the Institute. The Twenty-first annual general meeting of the Institute was marked by a " coming-of-age " celebration, which saw the Institute's membership pass the 2,000 mark. On this occasion, in addition to the annual dinner, a reception and conversazione was held, by the courtesy of the Director of the Museums, at the Science Museum, South Kensington. Exhibits of interest in connection with the activities of the Institute were arranged, and a large number of members an dguests attended what was generally regarded as a highly successful gathering.

In September, the Institute held its annual Autumn meeting for the first time in Germany. The meeting was held at Düsseldorf, by invitation of the Verein Deutsche Ingenieure and of the Deutsche Gesellschaft für Metallkunde, at a date which made it consecutive with the annual meetiug of the latter society. At the invitation of the Deutsche Gesellschaft für Metallkunde, the

President delivered before that society an inaugural " Guest Lecture," choosing as his subject " Physics and Metallurgy." Members of the Institute were invited to attend the meeting, an dmembers of the German society were invited to attend the Autumn meeting of the Institute of Metals; a number of German metallurgists responded to this invitation. The Autumn meeting at Düsseldorf was marked by one of the largest attendances of members and ladies—310 in all, includin grepresentatives of 18 nationalities—which has yet been recorded at any Autumn meeting—a fact which confirms the opinion of tbe Council that Autumn meetings abroad, at suitably selected centres, are a welcome feature in the arrangements of the Institute.

The successful meeting of the Institute at Düsseldorf, following upon the meeting of the German society, brought forth the suggestion that closer international co-operation was desirable, particularly in regard to metallurgical research. This suggestion was warmly taken up by the French and German members of the Institute present at Düsseldorf and, as a result, an effort has been made to bring about a preliminary conference in London for the purpose of discussing the possibility of forming an International Metallurgical Research Organization which should secure closer co-operation in the future. The Council has placed the facilities of the Institute of Metals at the disposal of this preliminary conference, and it is hoped that successful results will be achieved.

Another important development during the past year is the decision of the Council to participate in the movement for the erection of a joint building for housing a number of scientific and technical societies which at present are scattered in offices in various buildings in different parts of London. The scheme for a joint building originated with the idea that the principal metallurgical societies, including the Institution of Mining and Metallurgy, the Iron and Steel Institute, and the Institute of Metals, should be accommodated in a single building. The scheme has, however, been extended to include a considerable number of other societies and institutions, including an important group of chemical societies. The Institute has been actively represented on the various committees formed with a view to exploring the possibilities of such a scheme and, subsequently, of organizing an appeal for securing the necessary funds. The scheme has now progressed to a considerable extent; substantial contributions have been promised from a number of sources, and it is hoped that the purchase of a site and the erection of a building may proceed in the near future. In deciding that the Institute should participate in this scheme, the Council feels that by co-operation witn other technical and scientific bodies in this way the best interests of the Istitute will be served. It is anticipated that not only will such a scheme provide better accomodation for the actual offices of the Institute, as well as the use of a lecture theatre, but also that it will facilitate a closer co-operation between the participating societies, with possibly considerable resulting economies—particularly in regard to their publications—while it will also secure the more effective presentation of the views of technical and scientific bodies on all questions of public importance with which they are concerned. While the Institute is now fully committed to participation in the joint building scheme, it should be noted that beyond a smal lcontribution to the preliminary expenses, no financial obligations have been incurred or contemplated beyond the undertaking that when the building is ready the Institute will rent accommodation at least equal to its present rooms at a total cost not greater than is now paid.

Corrosion Research.

Proposals were made during the year for the transfer to the British Non-Ferrous Metals Research Association of the control of the research which has been conducted continuously by the Corrosion Research Committee of the Institute of Metals since 1910. As the Committee's financial year ended on effected as from January 1.

Henceforth the work will be controlled, directed and financed by the Research Association. It will be continued on its present general lines by the Investigator (Mr. R. May, A.R.S.M.), working in the laboratories of the Royal School of Mines under the supervision and guidance of Professor Sir Harold Carpenter. It is understood that the sub-committee responsible for the work will include a strong representation of the Institute of Metals and—if possible—of some of the users of condensor tubes who have been members of the Corrosion Research Committee.

In order to mark the origin and continuity of the work it has been suggested by the Research Association that the investigation should in future be known as " The Institute of Metals Corrosion Research."

In relinquishing control of an undertaking that has occupied a prominent place in the Institute's activites for twenty years, the

Council would express its good wishes for the future success of the research under its new auspices, and would thank all those who, in the past, by their assistance—technical, advisory, financial and otherwise—have enabled the work to be continued up to its present state of development.

Papers were then presented for discussion as follows :—

The Early Use of the Metals. By DR. A T. RICKARD, A.R.S.M.

So far as is possible within the limits of a single paper, a world survey is given of the early history of metals, and particularly of the non-ferrous metals. The industrial history of mankind is divisible into two major epochs—a Stone Age and a Metal Age. Between the two main epochs there was a transition period, when metals found in their native state were employed, but were not yet melted, or extracted from their ores. The melting of copper probably preceded its extraction from minerals by some centuries, and the production of bronze or hardened copper was a later stage in metal culture. The critical event in the industrial history of man was the first melting of metal out of stone, and this appears to have occurred about 3500 B.C. Metal articles fashioned at earlier periods were made from native gold, silver, or copper, or from meteoric iron. A bibliography is given, and much historical and other evidence in support of the views of the author.

The Composition of Eutectics. By DR. D. STOCKDALE, M.A.

The author has held the view for some time that in a binary eutectic the atoms of the two elements are present in a simple ratio. The experimental work here described was undertaken in order to get definite evidence for or against this view. Although this object has not been attained, yet the results in themselves are of interest.

A very sensitive apparatus for the taking of cooling curves is described, and a new method for the determination of the liquidus from such curves is given.

The eutectic systems examined were as follows :— Aluminium-copper, antimony-silver, cadmium-tin, cadmium-zinc, copper-silver, and lead-tin.

Experiments on the Influence of Gases on the Soundness of Copper Ingots. By N. P. ALLEN, M.Met.

The presence of hydrogen in molten copper can cause serious unsoundness in the ingots cast from it. This unsoundness has been examined, and methods for its avoidance are described.

The unsoundness found in commercial ingots is not, however, due to hydrogen alone, but to hydrogen and cuprous oxide together, which react in the solidifying metal to evolve steam. This phenomenon is very difficult to suppress, so long as cuprous oxide is present in the metal.

Those elements which, when added to copper, endow it with the ability to cast soundly, do so by reducing the cuprous oxide present.

Carbon monoxide, carbon dioxide, and nitrogen are inert, so far as the formation of blowholes is concerned.

Experimental evidence in support of these statements is given, and a method is described for studying the equilibria between hydrogen and cuprous oxide when present together in molten copper.

(*To be continued.*)

NOTICES OF BOOKS.

Organic Syntheses, Vol. X. Edited by HANS T. CLARKE. Pp. viii. 119. New York : John Wiley & Sons. London : Chapman & Hall. 1930. Price 8s. 6d.

Organic Syntheses has established itself as an annual publication of satisfactory methods for the preparation of organic chemicals, and the present volume lists 31 new ones. Each substance is prepared on as large a scale as laboratory facilities and apparatus permit, and every preparation has been tried out by another chemist in order to ensure that the method is satisfactory and can be repeated successfully by others.

Whilst all the substances whose convenient preparation is now described are all of general interest and some of the methods are of particular interest there is nothing of outsanding importance to cite.

Organic Syntheses has made itself popular among organic chemists who will be grateful for the present extension of the substances conveniently obtained by the methods given.

Bearing Metals and Bearings. By W. M. CORSE. Pp. 383. New York : Chemical Catalogue Co. 1930. Price : 7 dollars.

This monograph in the excellent series issued by the American Chemical Society differs in one respect from the other volumes in that it contains, in the middle, an extensive bibliography which is followed by a series of abstracts of the more important papers cited in the bibliography:

Such matters as the types of bearing metals, white metals, factors deciding the choice and the methods of testing are i

cussed. The question of lubricants is also adequately treated and the author's comprehensive bibliography of the literature between 1900 and 1928 is invaluable. The succeeding abstracts are also designed to save the technologist's time by giving him an idea of the salient features of any particular paper.

Finally the tables at the end which give the properties of bearing metals will be found very useful to all concerned with chemical engineering.

CORRESPONDENCE.

THE IMPORTANCE OF GERMAN.

To the Editor of THE CHEMICAL NEWS.

Sir,—The *Europa's* successful effort to beat her country's own Atlantic record reminds us once more how surely Germany is establishing her status in Europe and the world.

The reminder is one to which a nation of shopkeepers may well pay heed to-day when many of them talk in a fashion suggesting that the time has come to put the shutters up. In the year before the war we sold Germany £40,677,379 worth of goods. She was a good customer of ours then and the present possibilities of the German market may be measured by the fact that our exports to it last year were only two and a half million pounds short of the pre-war figure.

In these curcumstances it is gratifying to learn that the German language again seems likely to beat Spanish as the second favourite (French, of course, leading) amongst us. Certain firms are now arranging for their representatives to learn German and the German attitude is indicated by the collaboration of six eminent German professors with the Linguaphone Institute in producing a gramophone language course for students while German salesmen are learning English by the same means.

Trade with the Dominions overseas is a wholly admirable ideal; but we must not allow it to blind us to this vast market on our doorstep.

Yours faithfully,

J. E. MILLS,

M.P. (Lab.) Dartford.

House of Commons.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

7,774.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of 7-hydroxy-a-naptho-carbazoles. March 10.

8,048. 8,049. 8,062.—I. G. Farbenindustrie Akt.-Ges.—Manufacture of substituted phenol carboxylic acid. March 12.

8,446.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of vat dyestuffs. March 15.

8,418—I. G. Farbenindustrie Akt.-Ges. —Manufacture of 3-ethoxy-4-oxy-benzaldebyle. March 15.

Specifications Published.

326,217.—Johnson, J. Y. (I.G. Farbenindustrie Akt.-Ges. — Manufacture and production of nitrogenous vat dyestuffs.

326,185.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of catalysts containing free phosphoric acid.

326,149.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of aromatic nitriles.

Abstract Published.

324,311.—Dyes; intermediates. Dunworth, J. F., Thomas, J., and Scottish Dyes, Ltd., Earl's Road, Grangemouth.

Benzoylaminoanthraquinones are made by treating aminoanthraquinones, containing only one anthraquinone nucleus, at about 100° C. with not less than 3 molecules of benzoylating agent for each amino group to be benzoylated. The benzoyl product is separated by filtration and the excess of benzoylating agen re-nsed. Benzoyl chloride and o-, m-, andp-chlorbenzoylchlorides are specified as benzoylating agents. In examples, (1) 1-benzoylaminoanthraquinone is made by treating 1-aminoanthraquinone with benzoylchloride (5 mols.) at 100° C. in chlorbenzene or nitrobenzene solution. (2) to the filtrates from (1) more benzoylchloride is add- ie mixture used for benzoylating 1-

amino-anthraquinone. (3) 1-amino-5-chloranthraquinone is treated as in (1) and (2). (4) 1-amino-5-chloranthraquinone is benzoylated at 96-98° C. with excess of benzoylchloride in presence of sodium acetate and nitrobenzene and the product filtered. The filtrates are re-used. (5) Dibenzoyl-1 :5-Diaminoanthraquinone is prepared from 1 :5-diaminoanthraquinone and excess of benzoylchloride at 96-98° C.

The Provisional Specification refers also to acylation of aminoanthraquinones in general and includes the following examples: (1) 4 :4' diamino1 :1'-dianthrimide is benzoylated in chlorbenzene with an excess of benzoylchloride in the water bath (2) leuco-1 :4-diaminoanthraquinone is benzoylated in nitrobenzene at 95-100° C. with excess of benzoylchloride; benzoyl-1 :4-diaminoanthraquinone is obtained on filtration. (3) Benzoylchloride is added to the filtrates from (2) and the mixture used for benzoylating more leuco-1 :4-diaminoanthraquinone.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

ALKAVESCENT.

510,245.—Chemical substances prepared for use in medicine and pharmacy.—The Wellcome Foundation, Limited, 67, Holborn Viaduct, London, E.C.1. March 19.

URACON BRAND.

510,478.—Chemical substances prepared for use in medicine and pharmacy.—H. R. Napp, Limited, 3 & 4, Clement's Inn, Kingsway, London, W.C.2. March 19.

LANOTAR.

510,047.—Chemical substances used for veterinary purposes.—Thomas Lloyd Blackmann, trading as The Veterinary Products Company, 10, Cheapside, Leicester.

OONTEX.

510,149.—Vermin destroying preparations.—Walter Gwillim, 46, High Street, Brecon. March 19.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

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NOTICE TO AUTHORS & CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

TOOLS.

The student of to-day is presented with a variety of methods for advancing scientific knowledge, and it will not be out of place to mention briefly the so-called tools of science.

First and foremost is the purely experimental procedure in which results are recorded without any preconveived hypothesis; but here the need for highly specialised knowledge is necessary, so that the investigator has to make use of established facts and bring into requisition the findings of others.

Mathematics has played an important part in the advancement of knowledge and in providing new methods of investigation. Some of these methods are so firmly established that they become instinctively a means of elucidation. It occasionally happens that custom in this repsect has to be departed from, and old and established theories treated as tentative doctrines.

The working of nature is often made exceedingly simple in analytical treatment by applying certain elementary arithmetical principles. On this account the study of numbers and of their relationships has become one feature of importance, but when asked the Why and the Wherefore of some simple law that fits the experimental facts, the answer cannot always be given without arguing in a circle. The student becomes more or less familiar with the devices of the mathematician even if he is not a trained one himself.

In spectroscopic work the use of a simple arithmetical series, 1, 2, 3, etc., has proved to be of great use. Such numbers may portend something that is not fully understood, so very often the theory is fitted to the numbers. Nothing should be despised by the conscientious investigator though he may quite justly plead ignorance as to the real or ultimate basis of his results expressed in numbers.

Looking ahead, the investigator becomes so familiar with the properties of numbers, so to speak, that he is able to solve problems easily and accurately, but the technique of experimental method must still be cultivated as every new mathematical tool sooner or later leads to a new idea with regard to the experimental data, and this leads to new fields of research; and these often require exceptional skill and experimental judgment—only gained by experience—if the worker wishes to reap the reward of discovery.

BREWING AS A BRANCH OF SCIENCE.

By Professor ARTHUR R. LING, M.Sc., F.I.C

Paper read before the Royal Society of Arts, March 5th. Sir William Waters Butler, Bt., F.C.S., Past-president of the Institute of Brewing, presiding.

(*Concluded from Page 215.*)

In 1811 Vauquelin discovered that when starch is heated it is converted into a substance resembling gum arabic in its physical properties, whilst soon afterwards Kirschhoff observed that starch is converted into a crystalline sugar when it is boiled with dilute sulphuric acid, and Vogel found that in addition to sugar there is formed a gum which was named dextrin by Biot and Persoz. In 1814 Kirsehoff observed that starch migth be saccharified by the vegetable albumin of grain. Payen and Persoz in 1833 traced the saccharifying action of an infusion of malted grain to the presence of diastase.

So long ago as 1819 de Sausure examined the maltose resulting from the action of diastase on starch and it was more thoroughly examined by Dubronfaut in 1847. The existence of maltose as a distinct sugar was finally established by C. O'Sullivan in 1872 and he may rightly be regarded as the rediscoverer of the sugar. His further work was of great practical interest, showing as it did the influence of the mashing temperature on the nature of the products of the action of diastase on starch. The different dextrins which he isolated from the products when the reactions were allowed to proceed at different temperatures were regarded by him as non-reducing substances, although he never succeeded in isolating them quite free from reducing power. This work of O'Sullivan was of the highest practical value to the brewer, who was taught by it the importance of regulating his temperatures at different stages of the mashing process.

In 1879 H. T. Brown commenced his work with J. Heron, and subsequently with G. H. Morris and with J. H. Millar on the action of diastase on starch. In addition to confirming O'Sullivan's observations on the influence of temperature and expressing the results on a co-ordinate system, Brown and Heron showed the far-reaching effect of the reaction of the medium on the products obtained. The knowledge we now possess of the importance of maintaining the concentration of hydrogen ions at a definite value is the direct outcome of the work of Brown and Heron.

Starch is formed in the chloroplasts of leaves where in amylogenic leaves, it is, according to Sachs, the first visible product of photosynthesis. Leaf starch has the form of extremely minutes granules — transitory starch—devoid of the organised structure of the granules present in stems and roots—true reserve starch. According to experiments carried out in my laboratories by R. G. L. Beazeley, transitory starch isolated from potato leaves is readily converted into maltose when dissolved in water and treated at 50 degrees with the diastase of ungerminated barley. Transitory starch therefore consists of what I have called elsewhere α-hexaamylose.

The granules of reserve starch, on the other hand, consist of a mixture of two, in some cases three, closely related substances. So long ago as 1716 Leeuwenhoek observed that by heating starch granules with water the hulls remained undissolved, and he found these hulls in the excreta of birds. The observations of C. Nägeli, Sachs, W. Nägeli, Brown and Heron, and A. Meyer in the 19th century all go to show that starch granules consist of more than one substance. Maquenne and Roux put forward the view that the constituent of starch granules which enables them to form a viscous paste with water is a substance to which they gave the name amylopectin. Mme. Gatin-Gruzewska has devised several physical methods of isolating amylopectin and others have been suggested by Ling and Nanji. Amylopectin when thus isolated has the form of empty hulls. A chemical method of isolating a derivative of amylopectin has been described by Ling and Nanji. It was shown by Julian L. Baker in 1902 that when starch paste or soluble starch solution is treated with diastase of ungerminated barley, it yields some 60 per cent. of maltose, together with a dextrin which he named α-amylodextrin. Ling and Nanji believe that this dextrin is derived from amylopectin and propose to call it $\alpha\beta$-hexaamylose. The original amylopectin is a phosphoric ester and $\alpha\beta$-hexaamylose is dephosphated and depolymerised amylopectin. The presence of a beta as well as an alpha bond can be shown by the behaviour of certain enzymes towards the dextrin. It is, moreover, the parent of the maltodextrins of one, perhaps two, trisaccharides and of the so-called isomaltose. The hydrolysis of $\alpha\beta$-hexaamylose by different enzymes is now being studied in my department.

It was shown by Ling and Davis in 1902 that when the diastase of low dried malt is

allowed to act on starch paste ot 55 degrees for 95 hours, the constants are (a)D 138.5 degrees and R 96.7 degrees. The product was found to consist of cystalline maltose. Baker and Hulton have recently shown that when the diastase of ungerminated oats is allowed to act on soluble starch solutions at 50 degrees, after 24 hours the constants of the matters in solution are (a) D 135,0 degrees and R96.6 degrees. This result is extremely interesting and novel, but the conclusion of the authors that they see no way of reconciling this with the theory put forward by Maquenne and Roux and elaborated by Lin gand Nanji that the starch molecule consists of condensed amylose and amylopectin. Their results, they say, support the older and more simple hypothesis that starch consists of condensed maltose residues. I can only say that the evidence brought forward by Baker and Hulton is of too slender a character, and it ignores the work of Schardinger, Pringsheim, Samec, and many others.

The recognition that brewing is a branch of science led to discussions on how the status of the practical brewer could be improved, so that he might take his place with the members of other learned professions. Numerous suggestions were made from time to time as to how this could be brought about, and the matter culminated in the foundation by the Institute of Brewing of a scheme of examinations. The examinations are divided into two parts, Part I being a purely academic character, and Part II of a practical character. Those who have satisfied the examiners in Part I are not eligible to present themselves for Part II until they have had a subsequent five years' practical experience. Students who have obtained the Diploma in Malting and Brewing of the British School of Malting and Brewing of the University of Birminham or the School of Heriot-Watt College, Edinburgh, are excused Part I of the Institute's Examinations. This scheme has now been in operation for some years and it has undoubtedly achieved its objects. Successful candidates are awarded the Diploma of the Institute of Brewing which is the hall mark of the profession.

Another direction in which progress has been made in the science of brewing and its application to practice is the establishment of a research fund supported by the brewers throughout the country, who make annual contributions to it in sums assessed on the quantity of beer they brew annually. The scheme of research is now in active operation under the supervision of Mr. H. Lloyd Hind, who has been appointed organiser of research. The problems being dealt with are concerned with barley and malt, with hops, with yeast and with cask timber. Barley and malt are being dealt with at Rothamsted Experimental Station from crops grown at the Experimental Farm under standard conditions. Special mention may be made of the valuable work carried out at Rothamsted by Dr. Bishop, who is working on the Proteins of Barley and Malt, and by Mr. Day. Dr. E. Beavan's work on barley breeding and selection occupies a premier position in regard to barley as it has led to the cultivation of many new varieties of the cereal having desirable brewing qualities. The chemical work in hops, founded on researches in Germany, has placed the brewer in possession of methods whereby the bitter and preservative principles of hops may be characterised. For this we are indebted to the researches of Drs. Pyman and Walker and no less to those of Mr. A. C. Chapman, to whose work we owe all the knowledge we possess of the essential oil of hops. The quality of different hops from the point of view of practical brewing has also been studied by the late Mr. John M. Jones and by Mr. Lloyd Hind. One result of this work has been to show that the so-called Tolhurst hop, which is an exceedingly good cropper and therefore favourite with the grower, has a very long brewing value, both as regards its flavouring and preservative value.

COAL OUTPUT IN UNITED STATES.

The total January coal output, 50,729,000 tons, which included 44,445,000 tons of bituminous and 6,284,000 tons of anthracite coal, showed an increase over the two preceding months, but was below that for January, 1929; only one other month in 1929 (October) had a higher aggregate. The aggregate outputs of bituminous coal produced in December and in January, 1929, were 41,250,000 tons and 45,493,000 tons respectively, and of anthracite coal, 6,837,000 tons and 6,551,000 tons respectively. The aggregate and average daily output of pig iron in January showed further contraction. The tonnage made per calendar day averaged 91,210 tons, compared with 91,510 tons and 111,040 tons in December and January, 1929, respectively. Furnaces in blast at the end of January numbered 173, a net increase of 16 as compared with the beginning of the month,

FOURTH PACIFIC SCIENCE CONGRESS —JAVA, 1929.

By E. C. Andrews, B. A., F.G.S., Government Geologist of New South Wales.

(Condensed Report from the "Journal for Scientific and Industrial Research" Commonwealth of Australia.)

Object and History of Pacific Science Congresses.

In view of the growing importance of the Pacific Science Congresses, perhaps a brief statement as to their history and main objects may form a suitable introduction to the present report.

History.—The meeting of the British Association for the Advancement of Science, which was held in Australia during August, 1914, was the occasion of drafting plans to organize and co-ordinate scientific research within the Pacific region. The plans outlined at that time were delayed by the war, but the idea gained ground in the United States, and in 1920 the First Pan-Pacific Scientific Conference was called, the meeting places being Honolulu and Hawaii, and the Conference receiving strong support, financial and otherwise, from the Pan-Pacific Union. Fifty-six (56) delegates attended from Australia, Canada, Japan, New Zealand, the Phillipines, and the United States. One of the main features of this Conference was the attempt to stimulate a real geological mapping in the Pacific Region, whereby the main resources of the Pacific might be made known. A Hold-Over Committee was appointed at the close of the Conference, each country being represented by one delegate. In 1922, the Australian delegate was entrusted with the work of calling the second Conference in Australia Owing to the patronage and financial support of the Federal and State Governments, and to the sympathetic and excellent response by the National Research Council and other scientific societies and institutions of Australia, the Melbourne-Sydney meeting of 1923 was a magnificent success. Eighty-five eminent scientists and visitors from foreign countries attended, and the results proved so satisfactory that a Committee representing eleven countries was appointed to draft a Constitution and Bye-laws for a Permanent Organization.

The Japanese, impressed by the success of the Australian Meeting invited the Congress to visit Japan during 1926. The Third Congress was just as, or even more brilliant and successful than the Australian Meeting in the matter of organization, discussions, and scientific excursions. This Third Congress founded the Pacific Science Association, drew up a Constitution and Bye-laws, dropped the prefix "Pan," and placed the promotion of scientific work on Pacific problems more in the front.

The members of the Pacific Science Association are the countries which control lands either within, or bordering, the Pacific. The main objects of the Association are :—

(*a*) To initiate and promote co-operation in the study of scieutific problems relating to the Pacific Regiou, more particularly those affecting the prosperity and well-being of the Pacific peoples.

(*b*) To strengthen the bonds of peace among Pacific peoples by promoting a feeling of brotherhood among the scientists of all the Pacific countries.

"As a means of attaining these objects, the Association shall organize Pacific Science Congresses."

"The objects for discussion at Congresses shall include all branches of physical and biological sciences. Their scope, however, shall be so limited as to comply with the conditions specified in Art. 2 of the Constitution."

The Fourth Congress was held in Java during May-June, 1929. A summary of the Congress activities is supplied herewith.

Summary of Work of Java Congress.

Personnel of Congress.

Australia sent nine members and six participants. Of these, the Commonwealth Government was represented by five members, and the Australian National Research Council by seven members.

Names of Delegates.—Mr. E. C. Andrews, Professor A. N. Burkitt, Dr. Constance Ellis Professor E. J. Goddard, Mr. G. H. Halligan, Dr. I. M. Mackerras, Professor A. R. Radcliffe-Brown, Mr. C. A. Sussmilch, and Professor N. T. M. Wilsmore.

Participants.—Miss Ida Brown, Mrs. Burkitt, Miss E. E. Carment, Mrs. Goddard, Mrs. E. Scott, Mr. G. L. Windred.

In addition to the Australian Delegates as given above there were present some 186 members and 66 participants present, 21 from China, 3 from Great Britain, 42 from Japan, 38 from Netherlands, 23 from Netherlands-Indies and 41 from the United States. Most countries were represented.

Address of Welcome by Governor General of the Netherlands-Indies and Replies.

The Address of Welcome was delivered in the Law School Hall, at Weltevreden, by His Excellency, Jongheur, Dr. A. C. D. De

Graeff, the Governor-General of the Netherlands-Indies. His speech, as also the whole of the Congress proceedings, was in English. His Excellency pointed out that scientists before him were prepared to attempt the solution of the scientific problems of the Pacific "*standing aloof from politics and free from* national chauvinism and other more or less egotistical motives." He was proud to welcome the scientists "gathered here to work together for the twin cause of Science and Civilization."

The President, Professor O. De Vries, in his opening address, following immediately upon that of the Governor-General, laid stress upon the objects of the Pacific Science Association, upon the events which led up to the formation of the Pacific Science Association, and especially upon the part played by science in promoting harmonious social relations between nations. "Science it is," he said, "that brings us together to-day, and, of all human motive powers, science is undoubtedly one of the foremost in establishing international bonds. Religion, music, the arts, all form powerful ties between human beings, but, with their strong appeal to personality and sentiment, they divide as often as they unite. Science, with its neutral and impartial character, has *proved itself far more suitable as a common* meeting ground for all peoples."

The leaders of the Delegations from Australia, Canada, China, France, Great Britain, Hawaii, Japan, Netherlands, Netherlands-Indies, New Zealand, and the Phillipine Islands, made suitable replies to the Ad dresses of Welcome.

Scientific Programme.

The work proper of the Fourth Science Congress comprised divisional and joint discussions on scientific problems having a Pacific scope. This more technical portion of the Congress commenced on 18th May, and concluded on 24th May, 1929. For this purpose, the place of meeting was moved from Weltevreden (Batavia) to the Technical Faculty (University) of Bandoeng.

It had been ascertained, at previous Congresses, that the time allotted for scientific discussions did not permit of the individual presentation of all papers prepared. To meet this difficulty the procedure adopted at Bandoeng consisted of a general presentation, after previous analysis of all papers submitted in time and bearing on a given discussion by a recognized authority on the subject. Chairmen were appointed also from distinguished delegates. Time was reserved for general discussion after the leader's presentation. The leader would then be expected to co-ordinate the results and frame a resolution, if necessary, to present to the Committee on Recommendations for presentation later to the Pacific Council.

The subjects discussed were agriculture, anthropology, fisheries, forestry, geography, geology, meteorology, oceanography, seismology, volcanology, and wireless telegraphy.

Main interest from the economic and social view-point, centred round rice cultivation in the Pacific; the cultivation of tea, coffee, coconuts, sugar, cinchona, oil palms, and rubber; plant pests; soil surveys and other soil research work; forestry and timber research; scientific and commercial development of fisheries; weather forecasting; ocean charting, and other problems connected with oceanography; earthquakes and volcanic phenomena; preservation of social ural monuments; the improvement of social conditions of native races; and the history of, and relationships between, the various native races of South-eastern Asia.

The main resolutions arising from the scientific programme dealt with—

- (i) the necessity for co-operation "to revise the data given by the Geological Congress at Toronto, in 1913, with regard to the coal resources of these countries."
- (ii) "Ensuring a complete international oceanographic survey of the Pacific Ocean," (hydrographical, biological meteorolgical, physical and chemical).
- (iii) The study of cross pollination in rice.
- (iv) The necessity for soil surveys and soil classification within all Pacific regions.
- (v) The problem of land utilization " . . . whereas the problems of food production, population, pressure, and international commerce are closely related . . . and whereas the Pacific Science Association is more closely related to the physical aspects of these problems than any other international body; be it resolved that the President of this Congress be empowered to appoint the Chairman of a standing committee to deal with the question of classification and land utilization."
- (vi) Estimates of forest resources within the Pacific.
- (vii) Pacific economic entomology.

SUBJECTS CONSIDERED BY THE PACIFIC SCIENCE COUNCIL.

The Council is limited in number to fifteen, comprising one representative each from various countries within the Association. Fourteen countries are, at present, included.

A Committee of three was appointed to prepare matters under consideration for presentation to the Council. The Committee consisted of the President, the Leader of the Japanese Delegation, and the Leader of the Australian Delegation. The subjects under reference to the General Council are discussed in the paragraphs that follow :—

(i) An application by France for the admission of French as an alternative language was considered. The main reasons for the adoption of English as the Congress language were summarized by the Japanese and Australian leaders. The result of the deliberations was that the French themselves proposed that English be retained as the language of the Congress.

(ii) *Medical Science.*—The possible advisability of dealing with medical science by associations other than the Pacific Science Council has been stressed recently, but it was pointed out by the Australian Leader, both in the official reply to the Addresses of Welcome, and in the Council itself, that the Constitution specifically states that " all branches of physical and biological sciences" shall be included in so far as they improve the condition of the Pacific peoples. Furthermore, it was pointed out that malaria, dengue, filaria, leprosy, hookworm, plague, and so on, have a Pacific distribution in the main, and moreover, that they, together with tuberculosis, venereal disease, and so on, appear to have a Pacific facies, particularly within the Inner Pacific. Climate, also, as affecting the settlement of the white races within the Pacific, needed consideration.

(iii) *Agricultural Section.*—In certain quarters, it was thought that agriculture, in common with medical science, might better be left to more local associations. This was reflected in the Third Announcement by the President of the Fourth Congress—

" Agriculture, therefore, may find it more suitable to organize in the future on another scope, as has already taken place in the case of medical sciences, which find full satisfaction in the Far Eastern Association of Tropical Medicine. Silviculture which we welcome at our Fourth Congress where it finds a suitable meeting place, may, or may not, decide to prefer a Pacific above a Far Eastern or a Tropical scope. The veterinary sciences are well on their way to organize on a tropical basis, and do not feel the need to meet at our Congress any more than the medical sciences with their Far Eastern Congresses of which the last three took place in 1923 (Singapore), 1925 (Tokyo), and 1927 (Calcutta)."

It was decided, as in the case of medical science or hygiene, to leave the matter of formation of an Agricultural Section to the Canadian Committee. Nations desiring discussions on these matters are to prepare papers for presentation to the Canadian meeting.

(iv) *Limitation of number of Delegates to Congresses.*—The increase in the number of delegates, especially of participants, has led to difficulty in the matter of suitable accommodation, especially during excursions.

A tentative scheme was drawn up by the Organization Committee, whereby it was considered advisable to limit the number of delegates to 200, the allotment being as follows :—

Australia 10, Canada 10, China 10, Netherlands Indies 10, Russia 10, Distinguished Visitors 10, Japan 15, United States 25, France 5, Great Britain 5, Holland 5, New Zealand 5, Philippines 5, Straits Settlements and Federated Malay States 5, Hawaii 5, Siam 3, Hong Kong 2, Macao 1 or 2, Indo-China 10.

It was considered advisable to allow the wives of delegates to attend.

It was decided to appoint a sub-Committee to deal with this matter, the Committee to consist of the President (Dr. De Vries), together with the leaders of the Australia, Canadian, Japanese, and United States Delegations. A report will be furnished to the Council for the Canadian meeting.

(v) *Application of Indo-China.*—The application of Indo-China to join the Pacific Science Association was acceded to unanimously by the Council.

(vi) *Places of Meeting of Congresses.*—Invitations to act as host for the Fifth Pacific Science Congress were received from Canada and Indo-China. The Council decided to accept the invitation of Canada for the Fifth Congress (1932). Thereupon Indo-China extended an invitation to the Congress for its Seventh Meeting, in 1935, which was accepted unanimously.

EXCURSIONS.

Numerous excursions were arranged, both

before and after the scientific programme. These were excellently conducted, and were designed to supply the delegates with an idea of the potentialities of Java.

GENERAL CONCLUSIONS.

In reviewing the Fourth Pacific Scieuce Congress, several points appear to be worthy of note .

(a) The meeting was attended by many more delegates than any previously held. The Honolulu (Hawaiin) Congress was attended by fifty-six (56) foreigners, the Australian Congress (1923) by 80-85 extra-Australians, the Japanese Meeting (1926) by 142 outsiders, while the Java meeting was attended by 195 foreign delegates and 73 foreign participants. This ever-increasing attendance of distinguished foreign scientists indicates the general success of the Congresses. Their continuance appears to be assured, as shown by the eagerness of Canada and Indo-China to act as hosts for the Fifth and Sixth Congresses respectively.

(b) The employment of one language at the Congresses tends to promote a spirit of goodwill between the delegates from the various countries. Incidentally, it may be noted that, during the important excursions the delegates were received enthusiastically by the governing bodies and by the general public. This feature was particularly marked during the Japanese (1926) and Javanese (1929) Congresses. It would thus appear that the Congresses are powerful instruments in the promotion of harmonious social relations betwen the various Pacific peoples.

(c) The problems of agriculture, anthropology, forestry, fisheries, biology, oceanography, seismology, weather forecasting, and wireless telegraphy, appear to have been approached by the Congress in a manner conducive to the improvement of the material and social conditions of the Pacific peoples. Especially was this noticeable in regard to the cultivation of rice. In this connexion, it may be pointed out that the recent experiments in rice irrigation within the Murrumbidgee area of New South Wales arouse the greatest interest among the authorities on rice cultivation within the Western Pacific.

In oceanography a very valuable contribution was made by Mr. G. H. Halligan. His charts of the Australasian Region, showing the curves for equal temperature, and so on, for the years 1925, 1926, 1927, and 1928, were of very great assistance to the International Oceanographic Committee.

With regard to anthropology, at the Third Pan-Pacific Congress (Tokyo, 1926), a resolution was carried to the effect that—

"The utilization of anthropological knowledge be made a subject of prime importance for discussion at the next Congress."

As a result, Dr. B. Schrieke, adviser in these matters to the Governor-General of the Netherlands Indies, communicated with those "anthropologists and others who are known to have practical ideas relative to the needs of native peoples, asking them for brief summaries of their views and suggestions as to the more definite utilization of anthropology," and "to make a compilation of those views which shall be distributed among those to whom it may be of interest and value."

Under Dr. Schieke's editorship, a fine collection of articles dealing with the effect of Western influence on native civilisations in the Malay was published in volume form, and distributed to delegates after the commencemeut of the scientific programme at Bandoeng. On the other hand, this important publication was expected, especially by the Australian authorities on social anthropology, to have formed the basis of an important discussion at the Congress. Among others, Dr. Radcliffe-Brown, with a knowledge of Australian native races, attended the Congress prepared to contribute to the discussion. From an economic and social point of view, it seems advisable that this discussion of the effect of Western civilisation on native races should be emphasised. On the other hand, the magnificent discussions on the sociology and psychology of totemism and the history of native races of South-eastern Asia aroused intense interest and enthusiasm. Leaders of thought from various countries had assembled in these connections, and the meeting made history. In the keen debate on totemism, the leaders were Dr. Grafton Elliot Smith and Dr. Radcliffe-Brown. In physical anthropology, contributions were made by Doctors Elliot Smith, A .N. Burkitt, and H. L. Shellshear, all originally Australians.

Professor E. J. Goddard paid special attention to the needs of agriculture in Australia, and Mr. C. A. Sussmilch to geography and geology.

With regard to the subjects of geology and volcanology, there appeared to be lacking, in the excellent discussion provided, a cross-reference to economics. A discussion on a real geological mapping in the Pacific; another on the resources, within the Pacific, of minerals, such as lead-zinc, iron, coal, or oil would have strengthened the geological

programme materially. It is expected that an economic side will be provided for at the Canadian meeting.

(*d*) A matter for regret, from the Australian standpoint, was the absence of a section of hygiene.

(*e*) A most pleasing feature of the Congress was the efficient organisation shown by the Executive Committee of Java, and the splendid support, mainly moral, given to its efforts by the Government and Scientific Societies and Institutions of Holland.

The organization, in all ways, was excellent. The President and the other members of the Executive Committee received the 250 guests at the boats, distributed them, and arranged for their accommodation, transport, and their long excursions in an admirable manner. Guide books and other publications, itinerary cards, railway passes, hotel accommodation, were all provided, careful attention being paid to every detail. Moreover, all the published and verbal arrangements were conducted by the hosts in a tongue foreign to them. As with the Japanese in the Congress of 1926, so also in Java, no Hollander ever forgot that the language of the Congresses was English. The consummate tact and skill of the President himself was nowhere better evidenced than in the question of the Congress language when he addressed the Council in such a manner that a distinguished French delegate rose and proposed that English be retained as the language of the Congresses.

(*f*) The question arises as to the advisability or non-advisability of the limitation of the numbers of delegates. It certainly does seem, as in the cases of the Honolulu and Australian Congresses, that the best work is accomplished, from an economic point of view, by the deliberate choice of and extension of invitations to, recognized authorities on Pacific problems in natural science. the minimum of effort, with the maximum of efficiency, is thereby secured.

It is a great pleasure to record the very definite contributions to the important discussions by my Australian colleagues. It was a privilege to be Associated with so able a delegation.

(*From the " Journal of the Council for Scientific and Industrial Research " Australia.*)

INDUSTRIAL PRODUCTION IN 1929.

Industrial activity in the United Kingdom in 1929 was 5.8 per cent. greater than in 1928 and 4.5 per cent. above 1927, the respective index numbers (1924 = 100) being 111.6, 105.5 and 106.8.

THE BILLINGHAM STEAM AND POWER PLANT.

A Striking Example of Scientific Principles.

(*By a Well-known Engineer.*)

One of the most important papers ever read in the field of fuel technology and power plant engineering was that by H. A. Humphrey, D. M. Buist and J. W. Bansell, at a recent meeting of the Institution of Electrical Engineers. This described in full detail the new steam and power plant of Synthetic Ammonia and Nitrates, Ltd. (Imperial Chemical Industries, Ltd. , at Billingham, which ranks with the Ford Plant at River Rouge, Detroit, as the most striking industrial installation in the world. Perhaps the point of chief importance in connection with Billingham is the impressive demonstration to industry generally, and chemical works in particular, of the supreme value of the generation of electricity by means of prime movers operating on either the pass-out or back-pressure system, thus using all the exhaust steam for heating and process work.

The method contrasts with that adopted for the " Grid," the power stations of which operate with condensing turbines, whereby approximately 60 per cent. of the heat in the coal burnt underneath the boilers is thrown away in the condensor cooling water, due to the loss of latent heat. The "Grid" system is being enthusiastically advocated and backed by national propaganda, in which, seeing that it is not practical under present conditions to adopt back-pressure working for central stations, no reference to the merits of the system is made, so that the importance of the present paper is manifest.

The boiler plant at Billingham comprises eight very large forged-drum water-tube boilers, operating under maximum conditions of 800 lbs. pressure and 856 degrees F. superheated steam temperature, and each evaporating 269,000 lbs .of water per hour. The normal evaporation of the complete plant is 11,700 metric tons (25,786,800 lbs. per 24 hours, and this passes to a battery of five turbo-generators, each of 12,500 K.W. normal capacity. Three of these are of the back-pressure type, and upnder average running conditions about 60 per cent. of the total steam generated, that is 6,930 metric tons (15,278,720 lbs. is exhausted at 290 lbs. pressure and 650 degrees to the process mains, whilst 48,500 K.W. is generated by the drop in the steam pressure, without condensation and latent heat of steam loss. The other two 12,500 K.W. units are of the

ordinary condensing variety, to make up any extra power that may be required. No costs of any kind are given in the paper, as it is the policy of the Company not to disclose them, but the authors state that the figures for the production of electricity are far below that of any power station using condensing steam turbines. This obviously must be the case as the over-all thermal efficiency of such back-pressure sets is about 15-20 degrees, with 450-500 tons of cooling water required for every ton of coal burnt. There are of course other ample records available, and Messrs. Belliss and Morcom, Ltd., of Birmingham for example, have erected over 1450 back-pressure of pass-out plants aggregating more than 300,000 H.P., representing every possible condition of steam and power demands in about 70 different industries. From a national point of view it is imperative to develop the independent plant of this character, small as well as large, of which Billingham is now an outstandin gexample in the chemical industries.

EKA-CÆSIUM.

In the *Physical Review* (1930, *35*, 285) F. Allison and E. J. Murphy announce the probable existence of eka-cæsium, of atomic number 87, in the minerals known as pollucite and lepidolite. Their method of detection is a new one (see *Phys. Rev.*, 1930, *35*, 124). By their method they claim to have "consistently found minima at points of the scale which correspond to an element of the atomic weight [about 224] and valence [1 of course] ascribed to eka-cæsium. We have studied the substance in the chloride, sulphate, nitrate and hydroxide compounds, in each case finding the minima at points of the scale characteristic of an element of the chemical equivalent of eka-cæsium. Since the same element in different compounds produces its characteristic minima of light at different points of the scale, the fact that minima are observed in each of the four compounds at the points appropriate to element 87, affords evidence of considerable weight for its presence in the sample under test. The element appears to have several isotopes, as judged by the number of its characteristic minima. The method employed is sufficiently delicate to detect less than one part of a compound in 10^{10} parts of water. The work is still in progress."

The isolation of this element will be an achievement of great interest to chemists as eka-cæsium probably is the most electropositive element in the periodic table, fluorine standing at the opposite extreme.

GENERAL NOTES.

PHYSICAL AND CHEMICAL SURVEY OF THE NATIONAL COAL RESOURCES

In connexion with the Physical and Chemical Survey of the National Coal Resources which is one of the important aspects of the Fuel Research work of the Department of Scientific and Industrial Research, the Department has recently appointed a Committee to deal with the West Yorkshire Coal Area, with the following constitution :—

Representing the West Yorkshire Coal Owners Association—Mr. H. F. Smithson, Mr. D. H. Currer Bridges, Mr. W. L. Lloyd, Mr. G. F. F. Eager.

Representing the Midland Institute of Mining Engineers—Captain T. T. Adam, M.C.

Local Scientists—Professor J. W. Cobb, C.B.E.; Professor J. A. S. Ritson, D.S.O., M.C.

Representing the Geological Survey of Great Britain—Mr. C. E. N. Bromehead.

Representing the Department of Scientifis and Industrial Research—Dr. C. H. Lander, C.B.E. (ex officio), (Director of Fuel Research); Dr. F. S. Sinnatt, M.B.E. (ex officio), (Superintendent of the Coal Survey).

The object of the Survey is to investigate the characteristics of the various coal seams in the country with a view to their utilisation to the best advantage. Local laboratories are established in each area for the examination of samples and, when necessary, large scale investigations are carried out at the Fuel Research Station (East Greenwich) or elsewhere. The work of each local committee is to advise as to which seams should be investigated, to recommend what large scale work should be undertaken and to bring to the Department's notice any problems of particular local interest which may rejuire investigation.

The Surve yis now in active operation in most of the coalfields. Committees have for some time been dealing with the following areas, in each of which has been established a fully equipper Coal Survey Laboratory :— Scotland, Northumberland and Durham, South Yorkshire, Nottinghamshire and Derbyshire, North Staffordshire, and South Wales; whilst work in Lancashire and Cheshire is carried out for the Department in the Laboratories of the Lancashire and Cheshire Coal Research Association.

Arrangements are in hand for the establishment of a further laboratory to deal

with the coalfields of Warwickshire, Cannock Chase and South Staffordshire, and Leicestershire. When these have been completed the Survey will embrace areas producing 96 per cent. of the coal of Great Britain. The coal from the remaining coalfields will be dealt with at one of the above Survey Laboratories or at the Fuel Research Station.

TURKISH LAW FOR STABILISATION OF CURRENCY.

The Department of Overseas Trade has received a summary of the Law which was recently promulgated for the stabilisation of Turkish currency. The Law grants full powers to the Council of Ministers to enforce any measures which they consider necessary in connection with the control and limitation of purchase, sale and export of exchanges, money, bonds and shares.

At the time of the promulgation of the Law certain regulations were approved and issued by the Council of Ministers and published in the local press.

The sumary of the Law (in English and the regulations (in French) can be consulted at the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

MINING DEVELOPMENTS IN NORTHERN VANCOUVER ISLAND

Mining has been carried on since 1896 in that part of Vancouver Island north of the 50th parallel but the district is still poorly known to the outside world. The region contains deposits of copper, magnesite, lead and zinc, and occasional rich gold-quartz veins, as well as bog iron and some coal. None of the older properties have produced important quantities of ore, but to-day the outlook for mining according to Mr. H. C. Gunning of the Geological Survey, Dominion Department of Mines, is distinctly encouraging. The Consolidated Mining and Smelting Company of Canada, Ltd., has been developing the Old Sport group of claims on the shore of Elk Lake and has partially uncovered a large tonnage of copper ore which will probably be mined as soon as conditions for production become more favourable. In addition, the Coast Copper Company, after an extensive diamond drilling campaign, is proceeding with underground development of copper deposits on the old June group. These two enterprises are the most important on the west side of the island.

TOMATOES SYNTHETICALLY GROWN.

Plants Raised on Chemicals and Water.

Laboratory research has produced red ripe tomatoes without using any soil. The experiment was part of the extensive plant studies of the Smithsonian Institution in Washington, U.S.A. Instead of being placed in earth, the seeds were sprouted between damp blotters, and the roots were immersed in a solution of calcium nitrate, magnesium sulphate and monopotassium phosphate salts—the mineral soil which the plants naturally drew from the earth. The laboratory merely offered a handy supply, and the plants prospered. Growing the tomato synthetically is but one of the efforts to increase horticultural knowledge by study of this particular plant. Another laboratory found that the tomato apparently belongs to an agricultural union that works only 18 hours a day. Wheat, under artificial light, will work day and night, to grow up in 35 days. But the tomato successfully objects to a twenty-four hour working day.

SODIUM SULPHATE IN CANADA.

An important chemical industry is being established in the Province of Saskatchewan in which many large deposits of sodium sulphate occur. Sodium sulphate is largely in demand as a flux for the treatment of nickel ores and the International Nickel Company in association with Barium Reduction Corporation of Charleston West Virgina have organized the Horse Shoe Lake Mining Company to supply them with this material. The company has commenced the construction of a plant to cost $500,000 on their property comprising about 900 acres, located 54 miles south of Pasque, on the Canadian Pacific Railway. The deposit to be worked lies on the surface, having a depth in the centre of some 30 feet and is estimated to contain about 9,000,000 tons of the sodium sulphate The Horse Shoe Company has a contract with the International Nickel for ten years calling for a shipment at the outset increasing each year. And shipment will also be made to the Barium Company. There are some 60 large deposits of sodium sulphate in Saskatchewan. In addtion to its use in the nickel industry sodium sulphate is in demand by rubber manufacturers. Germany has heretofore been the principal source of supply, but now that the attention of the corporations interested has been drawn to the sources of Saskatchewan, other operators are likely to enter the field before long.

THE TRAINING OF A CHEMIST.

At the Belfast sectional meeting of the *Institute of Chemistry, some time back*, Mr. J. C. A. Brierley, Head Science Master, expressed the opinion that in the English schools the syllabus in the advanced course in chemistry was of such an extent that if it were really known—which to his mind was impossible—it would be almost worthy of a honours degree. How far that syllabus was the work of the teachers he was unable to say, but undoubtedly it was to a considerable extent due to the universities, which seemed to require that successful candidates for their scholarships and exhibitions should be fed on facts as geese and turkeys are fattened for Christmas. To be a chemist, or indeed anything worth the while, one should be *something more than a fact collector.* The university system of grouping scholarship and exhibition winners with beginners was good neither for the beginners nor the others, and often resulted in the youth who had done his work well at school wasting his time during his first year at the university. If the school work was properly executed, it was something more than unjust that it should not be recognised, merely because some undergraduates were not up to the standard. If the school work was not good, the universities were still not without blame because the teachers had been through their hands. If the student's time were to be properly spent, teachers in schools and universities *must get together. At the end of* his degree course, the student should be ready to specialise in the direction in which he intended to spend his life and should have received a fundamental training which would enable him to work in any direction he desired, the specialised training being carried out under the supervision of experts in the particular domain in which he proposed to work.

PUBLICATIONS RECEIVED.

Propagation and Food Translation in the Common Milkweed. By Fisk Gerhardt (Iowa Agricultural Station) pp. 16.

The Wearing Quolity and other Properties of Vegetable Tanned and of Chrome Re-Tanned Sole Leather. By R. W. Frey and J. D. Clarke. Pp.18.

Push-pull Piezo-electric Oscillator Circuits. By J. R. Harrison. Pp.6.

Directory of Fine Chemicals. Produced by Members of the Association of British Chemical Manufacturers, 166, Piccadilly, W. Pp.56.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Thursday, April 3.

The essential oil of Backhousia Angustifolia. Part II. The isolation of naturally occurring β-diketones; angustione and : dehydroangustione. By C. S. Gibson, A. R. Penfold, and J. L. Simonsen.

The " phenolic " constituent of the essential oil has been shown to consist of two β-diketones which have been given the names *angustione* and *dehydroangustione* respectively. The conditions governing the occurrence of these two ketones in the oil have not been determined.

Angustione, $C_{11}H_{16}O_3$, is hydrolised by alcoholic potassium hydroxide to 1 :1 :3-*trimethyl*-cyclo*hexane*-4 :6-*dione* and acetic acid. The constitution of the dione is proved by its oxidation with potassium hypobromite to $\alpha\alpha\gamma$-trimethylglutaric acid.

Dehydroangustione, $C_{11}H_{14}O_3$, *on oxidation* with potassium hypobromite yields $\alpha\alpha\gamma$-trimethylglutaric acid.

Angustione and dehydroangustione are apparently the first β-diketones which have been found to occur in nature. Certain of their more important derivatives are described.

Attempts to prepare cyanide dyes from quaternary salts of 2-methylacenapthpyridine and of ms-*methyl-acridine.* By F. M. Hamer.

These bases were chosen as starting points because it was expected that cyanide dyes containing such nuclei would have their absorption and sensitising bands further into the red than would cyanides containing quinoline nuclei. The condensation product of *p*-dimethylaminobenzaldehyde with 2-methylacenapthpyridine methiodide is a photographic sensitiser, whilst that of *p*-nitrosodimethylaniline with the same salt is a desensitiser. The quaternary salt has been condensed with quinoline methiodide or ethiodide to give an *iso*cyanine and with 2-iodoquinoline methiodide or ethiodide to give a Ψ-cyanine, which dyes are sensitisers. *ms*-Methylacridine was prepared by heating acetyldiphenylamine with zinc chloride. Although the reactivity of *ms*-methylacridine is well known, its methiodide, of which greater reactivity might be expected, gave negative results in a number of attempted condensations. It was, however, condensed with 2-iodoquinoline methiodide and ethiodide. The absorption spectra of the new

dyes were different in character from those of *iso*-cyanine; the new dyes are, moreover, entirely devoid of sensitising properties.

10-Chloro-5:10-dihydrophenarsazine and its derivatives. Part XIII. Absorption Spectra. By C. S. Gibson, E. S. Hiscocks, J. D. A. Johnson, and J. Ll. Jones.

Additional information has been obtained regardin gthe position of the nitro-group in those homogeneous derivatives which, according to the mode of synthesis, may have one of two possible constituents. For example, it is shown that the product of cyclisation of 3-nitrodiphenylamine-6′-arsinic is 10-chloro-1-nitro-5 : 10-dihydrophenarsa zine (*a*).

The production of fog in the neutralisation of alkali with hydrogen halides. II. The Significance of the presence of ammonia. By R. W. Aldis and J. C. Philip.

Strongly acid fogs can be obtained by passing an air-HCl stream through caustic soda solutions, although water under the same conditions absorbs the acid completely. The formation of these fogs is now shown to be conditional on the presence of small quantities of ammonia in the caustic soda solution. The amounts and compositions of the fogs obtained from alkali solutions containing initially known quantities of ammonia have been determined, and it is found that fog production ceases when all the ammonia has been carried off from the caustic soda; it is recovered quantatively in the fog.

The fog droplets are of 10^{-4} to 10^{-5} cm. radius, and the solution of which they consist may be 2*N* in regard to hydrochloric acid and 0.3 in regard to ammonium chloride. The concentration varies with the water vapour pressure in the surrounding air. It is suggested that the first and necessary stage in the production of droplets in the gas bubble is the formation of a hygroscopic nucleus. This is provided by the ammonia escaping into the gas bubble from the caustic soda and the hydrogen chloride present in the bubble. Water vapour then condenses on the ammonium chloride particle, and hydrogen chloride dissolves in the solution so formed. The relatively low mobility of the droplets accounts for their escape as fog before they come into contact with the surface of the bubble.

SOCIETY OF PUBLIC ANALYSTS.

The Annual General Meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, March 5th, when the President, Mr. Edward Hinks, delivered his Annual Address. Dealing with the Standardisation of Analytical Methods.

The following were elected as Officers and Council for the year 1930 :—

President : Dr. J. T. Dunn. Past Presidents serving on the Council : E. Richards Bolton, A. Chaston Chapman, Bernard Dyer, Edward Hinks, P. A. Ellis Richards, G. Rudd Thompson, E. W. Voelcker, J. Augustus Voelcker. Vice-Presidents : J. T. Hewitt, A. More, W. Partridge. Hon. Treasurer : E. B. Hughes. Hon. Secretary : F. W. F. Arnaud. Members of Council : F. H. Carr, C. H. Cribb, N. Evers, D. W. Kent-Jones, G. Roche Lynch, H. W. Mason, G. W. Monier-Williams, C. J. H. Stock, G. Stubbs, J. R. Stubbs, A. R. Tankard, Geo. Taylor.

An ordinary meeting of the Society then followed, the President, Dr. J. T. Dunn, being in the Chair.

Certificates were read for the first time in favour of :—Charles Ambrose Adams, B.Sc., F.I.C.; Janet Warden Brown, Ph.D., A.I.C., D.I.C., and John Alexander Reddie, F.I.C.

Certificates were read for the second time in favour of :—Leslie Mansfield Adams; James Charles Harral; Donald Frank Harrington Button, A.R.C.S., A.I.C.; Hugh Childs, B.Sc., F.I.C.; John William Corran, B.Sc., Ph.D., F.I.C.; Archibald Orton Jones, M.A., F.I.C.; James Bruce Eric Patterson, M.Sc., A.I.C.; Frank James Smith, B.Sc., A.I.C., and Alfred Tingle, B.Sc., Ph.D.

The following were elected Members of the Society :—Ronald Gilbert Baskett, B.Sc.; Hugh Charles Loudon Bloxham, F.I.C.; Claud McClellan Bottomley, B.Sc.; John Butler, B.Sc., F.I.C.; Robert Ellison, A.M.C.T.; George Noel Grinling, F.I.C.; Albert Houlbrooke, M.Sc., A.I.C.

ROYAL SOCIETY OF ARTS.

Competition of Industrial Designs. 1930.

By kind permission of the Board of Governors of the Imperial Institute, the public exhibition of works sent in for this year's open competition of Industrial Designs organised by the Royal Society of Arts will be held in the Exhibition Pavilion of the Imperial Institute, South Kensington, S.W. Full particulars of the Scholarships and prizes offered in connection with the Competition for designs for Architectural Decoration, Textiles, Furniture, Book Production

Pottery and Glass, Posters, Showcards, etc., can be obtained from the Secretary of the Royal Society of Arts, Adelphi, London, W.C.2.

THE INSTITUTE OF METALS.

Twenty-second Annual General Meeting, March 12th and 13th.

(*Concluded from Page 222.*)

Gases in Copper and their Removal. By W. E. Prytherch, M.Sc.

In this paper are described experiments on the effect of gases, oxygen, hydrogen, and sulphur dioxide on the soundness of copper. The degree and nature of the unsoundness due to dissolved gases have been shown to depend on the conditions of temperature, of rate of solidification, and possibly of shape of ingot obtained during casting. In the present investigation it has been found that dissolved gases may be partially removed by (1) Slow solidification followed by re-melting of the copper; (2) passing an inert gas, such as nitrogen, into the molten metal; (3) melting *in vacuo*. Experiments carried out to determine whether oxygen would remove hydrogen from copper sufficed to show that the rate of oxidation of the hydrogen was so slow as to make this method unpracticable.

Unsoundness in Bronze Castings. By Edward J. Daniels, M.Sc.

The effect of some pure gases on the soundness of bronze, and of casting in sand moulds of metal subjected to various melting treatments, is described, and a tentative explanation of the cause of unsoundness occurring in practice is suggested :

(1) The observations of Karr and Rawdon and of Carpenter and Elam, with regard to the relationship between casting temperature and unsoundness of bronzes, have been confirmed.

(2) Variations in casting temperature affect the rate of solidification, other conditions remaining constant, and similar variations in rate of solidification obtained by constant casting temperature into moulds of different materials also affect the density of castings in the same way.

(3) Nitrogen, carbon dioxide, and carbon monoxide have been found neutral towards bronze.

(4) Hydrogen is capable of causing unsountness in bronze at certain rates of solidification, and this unsoundness can be suppressed by treatment with neutral gases.

(5) It is possible that normally occurring unsoundness is due to the combined presence of hydrogen and oxygen in the molten bronze. It is different in character from that produced by hydrogen alone.

(6) Improvement in density of sand-castings can be obtained by melting in a pot-furnace with a thin fuel bed and good draught, as compared with melting in a very thick fuel bed and poor draught. With pure copper this is not so to anything like the same extent.

(7) Degasification with nitrogen, deoxidisers, and pre-solidification gave negative results so far as improvement in density is concerned, but pres-olidification appears to increase the strength of the alloy.

Macrostructure of Cast Alloys. Effect of Turbulence due to Gases. By R. Genders, M.Met., F.I.C.

Observations are described which indicate that when an alloy is cast in a mould prepared by a coating of volatile material, the macrostructure of the resulting ingot may be considerably modified by the turbulence resulting from the evolution of gases by the mould coating. The manner in which this occurs and the influence of various other factors in the casting operation are discussed and illustrated.

Investigation of the Effects of Impurities on Copper. Part VI. The Effect of Phosphorus on Copper. By D. Hanson, D.Sc., S. L. Archbutt, F.I.C., and Grace W. Ford, B.Sc.

The paper describes a systematic investigation into the properties of copper containing up to 1.48 per cent. of phosphorus, in which the amount of other impurities has been kept as small as practicable. Previous published work on the subject is summarised. A series of billets of 1 1alloys containing from 0.014 to 0.95 per cent. phosphorus has been prepared and rolled. The investigation deals with method of preparation, macro and microstructure, hot- and cold-rolling behaviour, density, hardness, tensile tests at ordinary and elevated temperature, electrical conductivity, fatigue, properties, impact strength, softening temperature of cold-worked material, determination of the solubility of phosphorus in solid copper, and age-hardening tests. The tests relate principally to rolled material.

Phosphorus removes oxygen from copper and improves its casting properties. Small amounts of oxygen can be found together with phosphorus in copper, depending on the amount of phosphorus present. Removal of oxygen by phosphorus improves the cold-working qualities of copper. Cop-

per containing up to 0.95-1.2 per cent. phosphorus can be hot-rolled, and up to 0.79-0.95 per cent. cold-rolled from cast billet. Phosphorus improves all those mechanical properties of copper which have been studied, and raises the softening temperature of cold-worked material. It is seriously detrimental to electrical conductivity, which may be attributed to the fact that it is markedly soluble in solid copper. The wrought alloys of higher phosphorus content exhibit a small amount of age-hardening after suitable heat-treatment.

The Aluminium-Brasses. By R. GENDERS M.B.E., M.Met., F.I.C.

The work described comprises a study of the properties of the ductile aluminium-zinc-copper alloys. It is shown that, over certain ranges of composition, the presence of aluminium in brass has a beneficial influence in several directions, especially as regards resistance to corrosion and to oxidation at high temperatures. The composition of the alloys can be adjusted to give a wide range of mechanical properties.

The Diffusion of Zinc in Copper Crystals. By C. F. ELAM, M.A., D.Sc.

Some experiments are described which were made with the object of seeing of zinc would diffuse into copper crystals. This only took place to a limited extent at high temperatures. The method was further extended to brass crystals of different composition, and it was found that if a β brass crystal was heated in zinc vapour a layer of γ was deposited which was also a crystal. The relationship was found to be sometimes parallel growth and sometimes a twin. The diffusion of zinc out of a brass crystal was also studied.

Protective Value of some Electro-deposited Coatings. By L. DAVIES and L. WRIGHT, B.Sc.

The work outlined represents investigations carried out during the year 1929 on a large number of specimens of steel, brass, phosphor-bronze, and copper. The specimens were plated with cadmium, zinc, nickel and chromium of thicknesses 0.0001 in., 0.0005 in., 0.001 in., and 0.002 in., and were subsequently exposed to accelerated corrosion tests. The paper is concerned with the production of deposits of a thickness frequently specified or recommended, and with their comparative behaviour to corrosion sprays of salt and sulphuric acid.

Under the conditions outlined, cadmium afforded better protection than zinc against the sulphuric acid spray. Against the salt spray, the thinnest deposits of zinc gave better protection than the corresponding cadmium deposits. In general, for equal thicknesses of zinc and cadmium, the intrinsic protection afforded by the zinc more than compensates for its higher solution potential. Chromium deposits afforded no protection whatever to steel, but very good protection was afforded to the non-ferrous basis metals. A deposit of 0.002 in. nickel was found necessary to give any degree of permanent protection to steel. For general purposes, nickel deposits appear to be most suitable, but no deposit can be recommended unless the service conditions are known.

A Note on Zinc-base Die-casting Alloys. By R. LANCASTER, B.Sc. and J. G. BERRY, B.Sc.

The effect of adding small quantities of magnesium to a zinc-base alloy, hardened with copper and aluminium, has been examined. There is a variation in the physical properties, and a distinct change in the crystalline structure, with successive small additions of magnesium.

Atmospheric Action in Relation to Fatigue in Lead. By BERNARD P. HAIGH, M.B.E., D.Sc., and BRINLEY JONES, M.Met.

The paper gives a detailed account of a number of fatigue tests carried out under abnormal conditions that were specially devised to study the action of air in relation to fatigue in lead, it being believed that this action is representative of conjoint chemical and mechanical action. It is shown that an oil bath round the test-piece, or even a water-bath, greatly delays the fatigue in lead, and that a thin layer of grease delays fatigue appreciably. A bath of acetic acid appears to eliminate fatigue in lead, although a thin film of the same acid does not do so.

It is shown that the fatigue fracture of lead is intersrystalline only round the margin; and that, in general, the interior surface of a fatigue fracture differs in character from the marginal zone.

The experiments are regarded as showing that oxygen diffuses through lead subject to cyclic stress; and that, at an appreciable depth below the surface, a provokes a conjoint chemical and mechanical action that leads to fatigue cracking.

A Note on Metallic Magnesium. By W. R. D. JONES, M. Sc.

A comparison of redistilled magnesium of 99.99 per cent. magnesium and ordinary commercial magnesium. The redistilled magnesium is obtainable at such a reasonable price, in view of its purity, that it can be used in metallographic researches.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

On Tuesday, 11th March, 1930, the following paper was read.

The Diesel Engine as Applied to Road Transport. By MAJOR W. H. GODDARD, A.M.I.Mech.E., M.Inst.P.T.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated.—

Sinomenine. XV. Reduction of Bromosinomenine by Nascent Hydrogen. By KAKUJ) GOTO and REIKICHI INABA.

Thermodynamical Study of Mercurous Bromide. By FUSAO ISHIKAWA and YUJI UEDA.

Proteins XII. Globulins of the Polished-Rice. KINSUKE KONDO and TOSHIO ITO.

Thermodynamical Study of Chemical Change. VI. Thermodynamical Study of Potassium Chloride. EI-ICHI SHIBATA, SABURO ODA and SHIZUTO FURUKAWA.

Influence of Antioxidants on Oxidation of Unsaturated Fatty Oils. II. By BUNNOSUKE YAMAGUCHI.

X-Ray Studies on Acidic Clay. II. Chemical Constitution and Crystal Structure of Acidic Clay. By HAJIME ISOBE and TOKUNOSUKE WATANABE.

II. Coriarine, a Poisonous Constituent. By mposition ox TEa

Constituents of Coriaria japonica. Gray. KONO KINOSHITA.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

8,731.—Bohme, Akt.-Ges., H. T.—Preparation of aliphatic sulphuric acid compounds. March 18.

9,110.—Consortium fur Electrochemische Industrie Ges. — Manufacture of 1 : 1 : 2-trichlorethane. March 21.

8,546.—I. G. Farbenindustrie Akt.-Ges. —Production of halogen derivatives of anthraquinone-benzacridone series. March 17.

8,547.—I. G. Farbenindustrie Akt.-Ges. —Production of sodium hydrosulphite, etc. March 17.

8,670.—I. G. Farbenindustrie Akt.-Ges. —Production of halogen derivatives of anthraquinonybenzacridone series. March 18.

Specifications Published.

302,173.—I. G. Farbenindustrie Akt.-Ges. —Manufactupre of azo-dyestuffs.

302,174.—I. G. Farbenindustrie Akt.-Ges. —Concentrating aqueous acetic acid.

326,553.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of alkylamine derivatives of organic compounds.

305,140.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of aryl - carboxy - amido - ortho-thioglycollic acids.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1s. each.

Abstract Published.

324,631.—Waxes; esters; amides; acid anhydrides; bituminous compositions. —I. G. Farbenindustrie Akt.-Ges. Frankfort-on-Main, Germany.

Products resembling natural waxes and suitable for use in boot and floor polishes and the like are obtained by esterifying together, maybe in presence of a catalyst, *e.g.*, sulphuric or hydrochloric acid, montan *wax bleached by oxidation and a fatty*, aromatic, or hydroaromatic acid, by means of a polyhydric alcohol. Any free acids in the products may be wholly or partially converted into salts, esters, anhydrides, amides, or other —CO— compounds, or into mixtures thereof. Solid or liquid hydrocarbons, or oily, fatty, waxy, or resinous substances, containing no free —COOH groups may be added before, during, or after the esterification. The bleached wax may be replaced by a conversion product still containing free acid, *e.g.*, the product described in Specification 320,854, and the polyhydric alcohol by carboxylic acids, aldehydes, ketones, or phenols, containing 2 or more hydroxyl or other, *e.g.*, halogen groups capable of esterification under the conditions. For example: (1) 220 kg. of cocoanut oil fatty acids, 150 kg. of ethylene glycol or 300 kg. of polyglycol, and 1 kg. of 40 per cent. sulphuric acid are heated for about 1 hour at 120-130° C., then 1,000 kg. of montan wax bleached according to Specification 308,996 and consisting mainly

of free acids, 100 kg. of tallow acids, and 40 kg. of wool grease are added and the whole heated to 120-130° C. for 3 hours. The flexibility of the soft plastic product may be increased by melting with 25 per cent. of its weight of paraffin wax. (2) 20 kb. of coconut oil fatty acids. 5 kg. of naphthenic acids, and 7 kg. of ethylene glycol are stirred for ½ hour at 160° C., 100 kg. of montan bleached as described in Specification 305,552 are then added and the mass maintained for 4 hours at 120-130° C. The free acids in the product are then esterified by heating for another hour with 9 kg. of benzyl alcohol. The Specification also describes the use of benzoic, salicylic and wool-grease acids, castor oil, tallow, and glycerol, and of calcium and barium oxides to form salts with the free acids of the products.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

WELFISH.

509,614.—Chemical substances prepared for use in medicine and pharmacy. —The Firm trading as The Welfish Manufacturing Company, 134, Upper North Street, Belfast. March 26.

PENTACROL.

510,107.—Chemical substances prepared for use in medicine and pharmacy.—Boots Pure Drug Company, Ltd., 37, Station Street, Nottingham. March 26.

SUBSAN.

510,110.—Chemical substances prepared for use in medicine and pharmacy.—Boots Pure Drug Company ,Ltd., 37, Station Street, Nottingham. March 26.

ATLACIDE.

507,858.—All substances in class 2 which includes chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes. —Atlas Preservative Company, Ltd., Windmill Lane Wharf, Deptford, London, S.E.8. March 26.

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in the history of the Sciences makes the book appeal to the general scientific public. It is also intended for use in Schools, where the History of Science occupies a place in the curriculum.

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NOTICE TO AUTHORS & CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

BRAIN.

The stars at night, they wink,
The sky at day is blue,
And man can laugh and think
As nothing else can do.—ANON.

Professor G. Elliot Smith's lecture on the human brain before the Royal Society of Arts, with Sir Oliver Lodge in the chair, is of very general interest and a few of the observations given on this memorable occasion will be presented here.

Gall established the fact that the white substance was formed of fibres, and that the grey matter of the cerebral cortex was the important part of the nervous system. This formed the starting-point in the attempt to interpret the comparative anatomy of the brain. Anatomists sought for distinctive features which would differentiate the brain of man from that of animals but the early criteria set up have been shown to be faulty owing to errors of observation.

Anatomists have proposed a variety of criteria to afford structural distinctions between the two sorts of brains, but in every case these criteria have been shown to be false, for there is no known feature of the human brain that is not present in the brain of the chimpanzee and the gorilla.

It is true that there are structural variations in the two sorts of brains, but the features of both brains are largely the result of the growth of visional powers. Man does not ' see ' quite in the same way as does an animal in so far as the visual development is greater in man. Man's immediate ancestors became differentiated from other mammals as the result of the enhancement of the importance of vision. In the case of an animal, smell is more developed than vision. In mammals vision for the first time acquires a real representation in the cerebral cortex, that hitherto had been essentially an olfactory instrument. Thus the enhancement of vision acts to stimulate the dominant part of the nervous system. The increasing influence of vision in the cerebral cortex opens the way for the eyes to control and direct skilled movements which are regulated by the cerebral cortex. Stereoscopic vision becomes an important factor and the higher powers of vision are found only in apes and in men; but, of course, in the human family the powers have reached heights not attained to by the ape. Man is the seeing animal who has acquired insight and foresight and the wider vision, obviously. The development of an æsthetic

sense in man controls his behaviour and this has reacted even to have modified in time the structure of his body. The eye is of enormous importance as a psychological instrument and it is through the eye that man has attained to a degree of intelligence far surpassing that of any lower animal.

In giving this summary of the lecture the writer has made liberal use of the language of Professor Elliot Smith.

In the discussion Sir Oliver Lodge referred to the skill developed in hitting the golf ball. In the reply, Professor Elliot Smith said :— . . . . "He had intended to discuss the importance of the intimate correlation of the hand and the posture of the whole body. That was an essential part of skill. The swing of the golf club rather than the force with which a man hit the ball was the esseutial factor in the attainment of success. Perfect balance, pose, timing and rhythm were as essential for the attainment of skill as the co-ordination of the muscles of hand and arm. The whole of the cerebral cortex was involved in any action. It was one of the achievements of the cerebral cortex that it was a single organ bound up with every one of its parts. In the swing of the golf club a man was using the muscles of his whole body. Keeping his eye on the ball meant that the player's attention was fixed upon the culmination of his skilled action; his hands and body carried out the muscular act without the direct guidance of vision; the attainment of skill was possible because the movements of joints, muscles, etc., were recorded in the brain in such a way as to integrate the swing of the club with the visual fixation of the ball's position."

EMISSION OF POSITIVE IONS FROM THORIATED TUNGSTEN. — SEARCHING FOR AN ELEMENT OF ATOMIC WEIGHT ABOUT 247.

H. B. Wahlin in a short letter published in the current issue of the *Physical Review*, page 653, says that, in investigating the emission of ions from thoriated tungsten, besides masses of 184 and 232 there is one of 247 ± 2. Evidence that the last-named one, a strange value obviously, is thorium monoxide is negative. Still it may be some compound, but the possibility of a new element is being investigated by means of X-rays.

NOTE ON THE SPECTROSCOPIC IDENTIFICATION OF EKA-CÆSIUM — FURTHER REMARKS ON IONISATION POTENTIALS, AND THE PHYSICAL CONSTANTS DILEMMA.

By F. H. Loring.

Explanatory Note.—*In this article the* heavy-faced numbers represent the magnitude of the value that cannot be seriously questioned, while the respective numbers following, in lighter face, represent the uncertain part of the value. *Many of the calculations* are carried out far into the decimal region, or to equivalent figures, for comparative purposes, but they do not otherwise represent great precision.

In this Journal (1930, *140*, 178-181, 202) the ionisation potentials of the alkali metals were discussed in connection with the principal series lines of eka-cæsium, as calculated by a method of extrapolation.

In order to make this discussion more complete, Fig. 1 is here reproduced on a smaller scale with the theoretical potentials plotted thereon.

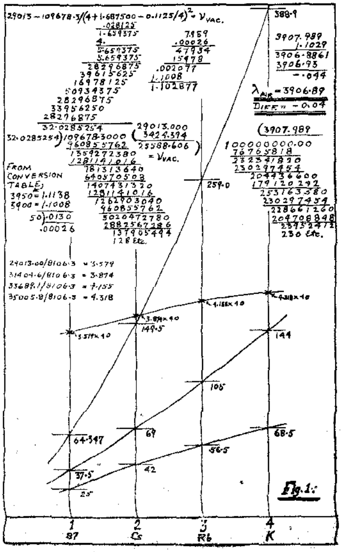

Fig. 1.

The multiplier, 40, is used to make the plotting more accurate, but the dividing constant now used is taken from Birge's paper on the probable values of the general physical constants (*Phys. Rev. Sup.*,* 1929, *1*, particularly page 62) based on the established equation :—

Wave- number associated with one absolute volt $= \nu_0 = e \times 10^8 / hc^2$,

$$\text{when } e = 4.770 \times 10^{-10},\quad h = 6.547 \times 10^{-27},\quad c = 2.99796 \times 10^{10},$$

$$\text{then } \nu_0 = 8106.31.$$

In view of the possibility of these constants being appreciably altered, except of course c, as stated in the present writer's article in this Journal (1930, *140*, 210-212), other values may be considered in this connection. For example, the following equation demands a higher value for h. In this equation the "four-fold" idea is introduced for the first time, the basis of this feature, though obscure, has been expounded in the article just referred to.

$$c = R_\infty / \{\mathbf{1} \times \mathbf{2} \times \mathbf{3} \times \mathbf{4} \times (\mathbf{1}+\mathbf{2}+\mathbf{3}+\mathbf{4})^{-33} / h\},$$

$$\text{when } R_\infty = \mathbf{109737.37}\dot{3}\dot{7},$$

$$h = \mathbf{6.55}\dot{6} \times 10^{-27},$$

$$\text{then } c = \mathbf{299796}40853.$$

Part of the above equation may be expressed factorially by writing **4!** instead of $4 \times 3 \times 2 \times 1$.

Furthermore, assuming with Eddington that $hc/2\pi e^2 = \mathbf{137}$ exactly, then using the above values, e comes out at $\mathbf{4.77}864257\dot{1}3 \times 10^{-10}$.

From the well-known equation—

$$R_\infty = 2\pi^2 e^5 / h^3 c^2 (e/m),$$

$$R_\infty = \mathbf{109737.37}\dot{3}\dot{7},$$

$$\text{when } 2\pi^2 = \mathbf{19.739208802},$$

$$e = \mathbf{4.77}864257\dot{1}3 \times 10^{-10},$$

$$h = \mathbf{6.55}\dot{6} \times 10^{-27},$$

$$c = \mathbf{299796}40853,$$

$$e/m = \mathbf{1.7}\dot{6}9276 \times 10^7.$$

Now the ionisation potential of the H atom is $R_H / \nu_0 = \mathbf{13.52}54$ volts (Birge's value is $\mathbf{13.52}99$ volts) when $R_H = \mathbf{109677.75}9$ (Houston's value used by Birge, *loc. cit.*), ν_0 being calculated from the first equation given above, but with the higher values just given, so that it is **8109.**02409. Using this dividing constant, instead of the slightly lower one above, as also shown on Fig. 1, does not appreciably affect the theoretical ionisation potentials plotted, as instanced here in the case of hydrogen.

These higher values call for some additional considerations of interest in connection with the article on pages 210-212 already mentioned. Before proceeding further it is to be noted that all the above equations are of a *spectroscopic* character.

It has been customary to calculate the value of m, the mass of the electron in atomic weight terms (O = 16 exactly), by the equation—

$$m = F / (e/m),$$

when $F = \mathbf{9650}$ in absolute E.M. UNITS.

$$e/m = \mathbf{1.7}\dot{6}9276 \times 10^7,$$

$$\text{then } m = \mathbf{0.00054}54 \ldots$$

The above value of F is a little higher than Birge's value (*loc. cit.*), but it is the one that Vinal and Bouvard advocate (see E. B. Rosa, G. W. Vinal, and A. S. McDaniel, *Bur. Standards Bull.*, 1914, *10*, 475; G. W. Vinal and W. M. Bouvard, *ibid*, 1916, *13*, 147).

This evaluation of m is not, however, spectroscopic, and if the value of m so found be used in the standard "spectroscopic" equation,

$$R_H = R_\infty / (1 + m/m_H),$$

$$\text{then } R_H = \mathbf{109677.}978,$$

$$\text{when } m = \mathbf{0.00054}54,$$

$$\text{and } m_H = \mathbf{1.00777} - \mathbf{0.00054}54.$$

R_H comes out too high, which points to the value of m being *too low* when operating, so to speak, *spectroscopically*; moreover, the atomic weight of hydrogen or its nucleus, as above, is perhaps not a true spectroscopic value in the physical sense implied by this equation.

The e/m value above is, however, higher than that obtained by Babcock (*Phys. Rev.*, 1929, *33*, abstract p. 268; *Astrophys. Journ.*, 1929, *69*, 43) from the Zeeman effect. It is also higher than Houston's value, but Houston partly made use of a non-spectroscopic equation as above.

By the deflection method, F. Wolf (see this Journal, pages 210-212) obtained a value agreeing closely with the one above,

* The title of this journal has been altered to *Reviews of Modern Physics*, beginning 1930, vol. 2, to conform to a ruling of the U.S.A. Postal Authorities.

but the method is *not* spectroscopic; so the question has again to be raised: Is the deflection value different from the spectroscopic value?

The present writer is aware that one or two of these possibilities are not quite in accord with present-day opinion, but the equations and figures speak for themselves as against experimental values.

Another question arises out of this study: e/m is obviously a *ratio*. Now a *true* ratio should involve quantities of the same kind. Therefore e and m are quantities of the same kind, and if m is variable in mass e should be proportionately variable, too. This seems contrary to current views, as, so far as the writer is aware, there has never been any suggestion that the positive charge could vary. In fact the very experiments that establish this ratio seem to rule out such an idea;† but when the ratio enters into a complex equation, perhaps there is a factor to be considered that has been overlooked. Or, again, perhaps Wolf's value is by accident in agreement with the calculated value above, which means that there is a hidden error in the deflection determination.

It must be remembered, too, that Eddington's "137" is here taken as absolute.

Returning to the computations above, if an attempt be made to evaluate N, Avogadro's number (Birge's value is 6.06436×10^{23}), from the equation—

$$e/c = F/N,$$

when $e = \mathbf{4.778}6425713 \times 10^{-10}$,

$c = \mathbf{299796}40853$,

$F = \mathbf{9650}$,

then $N = \mathbf{6.0541} \ldots \times 10^{23}$.

F. Zwicky (*Proc. Nat. Acad. Sci.*, 1930, *16*, 211-215) discusses the possible influence of the mosaic structure of crystals in connection with the determination of Avogadro's number, as this number is closely related on the one hand to the determination of the charge of the electron, e, and on the other hand to the absolute determination of the wave length of X-rays, as touched upon on page 211 (*loc. cit.*). At any rate, the above value seems nearer to the mark than 6.014×10^{23}, as resulting from Bearden's work—see table on page 211.

† It must be admitted that some of our notions are arbitrarily fixed and with changing knowledge, as in the case of relativity, these notions will be seen not to be fixed but themselves relatively changeable.

It will be seen that these newer values fall between the extreme values cited in these papers.

The use of recurring decimals in certain cases is not justified by experiment, obviously. To all intents and purposes these values are those rounded off to repeating figures rather than to noughts—in reality a compromise.

VALIDITY OF EINSTEIN'S EQUATION FOR RED-SENSITIVE SODIUM COMPOUNDS.

In a paper given at the February 21-22 meeting of the American Physical Society, titled as above, by A. R. Olfin of the Bell Telephone Laboratories, a new value for h has been obtained. The following is the abstract of this paper as appearing in the *Physical Review* (1930, *35*, 670):—"Using a photoelectric cell specially designed so that the cathode could be sensitised in a side compartment and then slipped into position within a soot-coated nickel anode, stopping potentials were obtained for electrons liberated by highly resolved light of wavelengths ranging from 3500A to 8000A. The cathode consisted of a nickel plate heavily coated with sodium and specially treated with sulphur and air (abstract, *Bull. Am. Phys. Soc.*, 1929, *4*, 2). The anode of such a cell is not sensitive to light, so the voltage at which the emission from the cathode just becomes zero is a measure of the true stopping potential. Plotting the voltages so obtained versus the exciting light frequencies a perfectly straight line is obtained. From the slope of this line, a value of Planck's constant h equal to 6.541×10^{-27}, significant to three figures, is obtained. It is possible with one cell to obtain stopping potentials for electrons released from sodium before and after treating it with sulphur and air. In such cases the voltage at which the photoelectric emission ceases is the same, but after treatment the current saturates at a higher voltage, exhibiting a change in the contact difference of potential of 0.8 volt."

The low value of h is particularly to be noted and the value compared with those given recently in this Journal. Should the above method of evaluating h prove to be sound and the value confirmed, then all the 'best' values of h will have to be altered slightly. The value on the left is only accurate to *three* figures, so that if the *one* becomes a *nine*, then 6.55 woud be practically the value to be taken. Birge's latest value is 6.547 ± 0.008.

RELATIVITY AND ÆTHER DRIFT.

Professor W. F. G. Swann in the *Physical ?eview* for February 15, 1930, discusses the :ther drift experiments in theory and its earing on the theory of relativity. This is very difficult subject to understand and it 'ould appear that even to-day the matter is ot settled. Miller has been making further ıeasurements, but the results are not yet ublished in detail.

Professor Swann abstracts his paper as ›llows (it is in reality an address presented t the Chicago meeting of the American 'hysical Society on November 30, 1929) :—

While æther drift experiments originally ıggested the line of thought which led to ıe formulation of the restricted theory of elativity, it would seem that the fundaıental significance of that theory does not epend primarily upon these experiments. 'he most logical origin of the transformaion of the restricted theory is to be found s a special case of the general-theory, and ıe purpose of the present paper is to show ow, with this in view, the fundamental 'orking content of the restricted theory, the ıvariance laws under the Lorentzian trans-›rmation, is something which has no fundaıental relation to the question of whether he æther drift experiments do or do not ive a positive result."

It is common knowledge that the null esults in the famous Michelson-Morley exeriments led Einstein to formulate his ıeory of relativity, whereby all attempts to ıeasure the velocity relative to the æther ive a null result, because, by the Lorentzın transformation equations no differential ffect is possible. This means that the ıws of a given system appear invariant to n observer moving relatively to that ystem. That is to say, they appear invarınt by the method of measurement as emanded by the transformation equations nd the proper co-ordinates as correlated by ıe Lorentz-Einstein equations. According › Swann there " will also be a multifold ıfinity of other sets of co-ordinates such hat if the laws be expressed in terms of hese, the statement will not be true."

Enough has been said here to excite the eader's curiosity to dip deeper into the roblem as set forth in this long paper of leven pages.

On page 346, Prof. Swann says : " I am erfectly aware of the fact that the equialence of the line element ds and the ds of xperimental measurements is frequently tressed. I merely wish to point out that uch equivalence amounts to an extra postulate, and a postulate not essential to the main content of the general or restricted theories [of relativity]—a postulate moreover which leads to such dangerous conclusions as are involved in the ' red shift ' of the spectrum lines of the sun, and which appears to place upon the theory [of relativity] a burden of prediction greater than it can bear."

ISOTOPES, REGULARITIES IN CONNECTION THEREWITH.

In the *Physical Review* (1930, *35*, 408-414) H. A. Barton gives some regularities in nuclear types (isotopes); the idea seems to be to arrange the isotopes so that they show symmetrical-cluster arrangements, which are characterised by a two-dimensional symmetry.

In J. A. V. Butler's *The Chemical Elements and their Compounds* (1930), page 172, an interesting and suggestive arrangement of the mass-numbers (isotopes) is given. This arrangement would seem to accommodate symmetrically the newly-discovered isotopes of masses, or mass-numbers, 13, 15, 17, and 18 (see W. F. Giauque and H. L. Johnston, *Journ. Am. Chem. Soc.*, 1929, *51*, 3528-3534; S. M. Naudé, *Phys. Rev.*, 1929, *34*, 1498-1499; A. S. King and R. T. Birge, *ibid*, *34*, 376 and 379).

The scheme shown by Butler may be drawn by following the directions thus :— Draw a vertical line and divide it into 44 equal parts, these parts representing mass-numbers up to Ca = 44; or, strictly speaking they represent the mass-number *scale*, since some masses may never be discovered so as to take up *all* the numbers. The distance between these points will be called a *unit*. Draw another line, parallel to the first one above, 5.5 units to the right. Draw a line from mass-number 16 (towards the second parallel line) having an angle, on the upper side, of 60°. Draw another line, normal to the last-mentioned one, at a place where it will intersect the right-hand vertical line *opposite* mass-number 15. Now where these lines intersect place a dot, this representing *oxygen* of *mass 16* and *atomic-number 8*.

Proceed to multiply this construction so that there is a rectangle, the space between the two vertical parallel lines, filled with lines crossing one another and forming squares.

It will be seen that the atomic-numbers are in 2-unit steps along the right-hand side,

while the mass-numbers are in 1-unit steps along the left, and where the lines cross dots can be inserted corresponding to the mass-numbers and atomic-numbers of the individual atoms or isotopes. As a result a more or less regular zig-zag pattern is developed centrally down the rectangle, which is a right-angled parallelogram, lines at the top and bottom being drawn in to complete the framing.

Three of these rectangles with crossing lines can be drawn to take all the isotopes, the widths of the respective rectangles being, say, 5.5 units (as above), 6.5 units, and 8 units. Or, the whole scheme can be shown in one very long right-angled parallelogdam, when working it out substantially in the above way. The wider rectangles are necessary to take a large number of isotopes (mass-numbers) per element (tin having as many as 11), and since they fall on one atomic-nnmber diagonal line the said rectangle has to be wider than in the instance of the one taking elements from lithium to calcium; but the widening of the rectangle is really governed by other elements than tin as will be seen when making the diagram and filling in the dots.

It is difficult to convey in words the success of the scheme, as it must be tried out with known isotopes in order to visualise properly the result, but striking regularities are thereby revealed.

BRITISH TIN RESEARCH.

New Developments Announced.

Plans for widening the scope and intensifying the activities of the Tin Industrial Aplications Committee were decided upon at a meeting held in London

Under the new scheme, the Committee proposes to undertake a certain amount of experimental research abroad, aid in the development of new processes and industries consuming tin, and stimulate possible markets. Expert advice will be given free of charge to any firms or persons desiring it. It has also been decided to change the Committee's name to the Tin Research and Industrial Applications Committee. The Committee's object is to promote the study of the economic uses of tin and to solve industrial problems, and they are prepared to give the fullest consideration to any metallurgical or manufacturing problems.

SOME RECENT ADVANCES IN THE CHEMISTRY OF ENZYMES.

By R. H. Hopkins, D.Sc., F.I.C.

General.—An enzyme may be defined as an organic catalyst of more or less specific action, and which is produced in living cells, but may function either inside or outside these cells. Theories as to the general nature and specificity of enzyme action divide themselves into two classes; first those which assume each enzyme to be specific for a definite substrate or for substrates possessing a characteristic linkage in their molecular structures. In this case it is assumed that a definite intermediate chemical compound is formed between enzyme and substrate. Secondly theories based on the colloidal character and behaviour of enzymes. Exponents of the former theories point to the specific action of maltase on α glucosides (such as maltose) of β glucosidases on β glucosides (such as amygdalin) and of peptidases on di and tri peptides (such as leucylglycine) and so on. The analogy suggested by Emil Fischer of a key fitting the corresponding lock illustrates this point of view. Exponents of the second theories (*e.g.*, Bayliss) are impressed by the great dependence of enzyme activity on colloidal conditions, gradations of dispersion and so on. However, developments in recent years have made it necessary to make use of and combine both of these conceptions to a certain extent. Whilst there is certainly a dependence of the *activity* of the enzyme on colloidal conditions, nevertheless it has been found possible to transfer an enzyme from its natural colloidal associates to others in another medium without change in its specificity, and sometimes even without loss of its activity. This has been achieved by Wilstätter and Waldschmidt-Leitz and their colleagues. The best summaries in English of their conclusions are to be found in (1) Wilstätter's Faraday lecture to the Chemical Society (*J. Chem. Soc.*, 1927, 1359 *et seq.*) and (2) " Enzyme Actions and Properties," by Waldschmidt-Leitz (Chapman and Hall). These workers consider that the assumption of an intermediate compound between enzyme and substrate to be the most useful working theory available. Wilstätter says " Enzymes are composed of a colloidal bearer and a specific active group which enables them to be bound to substrate and the composition of which at the same time conditions the colloidal nature of the entire complex." The views of Quastel and Wooldridge (1927) are slightly different and

more physical in conception—the idea of active centres and of surface functions being developed.

Activators.—Another important advance in general enzyme chemistry is with regard to activators. Apart from general activators such as certain mineral salts, which may increase the activity of an enzyme uniformly over its whole range, there are certain activators which are specific, and whose presence is necessary for certain ranges of the enzyme's activity. These activators, by themselves exert no enzyme action. An example is enterokinase which has no enzymic action whatever on proteins, but by its presence enables duodenal trypsin to attack proteins such as casein and gelatine on which trypsin alone has no action. But trypsin is an enzyme and can attack simpler proteins (*e.g.*, clupein) and peptones. A further example of a specific activator is hydrocyanic acid, which enables papain to attack certain polypeptides on which it otherwise has no action. The activation in this case is in the direction of simpler substrates—in contrast to that of enterokinase, which is in the direction of more complex ones. Hydrocyanic acid has recently been shown by Lüers and Malsch (1929) to activate the protease of green malt.

Separation and Purification of Enzymes.—Many methods have been employed from time to time to purify and separate enzymes. Firstly, precipitation from the aqueous extract by alcohol or acetone, followed by re-solution and re-precipitation. Often an enzyme loses activity through contact with strong alcohol, and also through elimination of certain associated substances (activators or co-enzymes) in the process of purification. This is well illustrated by the work of Ford and Guthrie (1908) on barley diastase. A second method is dialysis, by means of which some most useful results have arisen. In this way Harden and Young (1906) separated the enzyme and co-enzyme of yeast juice, and diastases from certain sources have been fractionated into starch liquefying and starch saccharifying constituents by Fricka and Kaja (1924) who worked with malt diastase, by Narayanamurti and Norris (1928) who worked with cholam malt diastase. A third device consists in submitting the medium containing more than one enzyme to conditions of reaction and temperature such that one enzyme is destroyed whilst the other survives. This method is successful with animal pepsin and trypsin, with the components of malt diastase as investigated by Ohlsson (1926), and it has recently been employed by me with the proteolytic enzymes of green malt. None of these methods is, however, of general application. The most useful and generally applicable method is that of adsorption.

Adsorption.—A brief general description of the principles underlying adsorption methods is contained in a recent communication by Hopkins and Burns, " The Proteolytic Enzymes of Green Malt " (1930). Recent advances in the chemistry of the proteolytic enzymes in general are also treated in that paper, and will not be repeated here. Fuller information on adsorption methods are to be found in the publications of Willstätter and Waldschmidt-Leitz already referred to. Whilst these workers have achieved considerable success with many enzymes of animal origin on account of their acid or basic adsorption properties, attempts at separation of the enzymes of malt have met with limited success. This seems to be largely due to the amphoteric character of these enzymes or of the substances intimately associated with them. They are consequently not so susceptible to such adsorbents as alumina and kaolin, and so, difficulties arise. This is illustrated by three papers on the proteolytic enzymes of green malt, all of which deal with adsorption methods. Lüers and Malsch (1929), Linderstrøm-Lang and Masakazu Sato (1929), Hopkins (1929).

The Proteolytic Enzymes of Yeast.—Dernby (1917) found that yeast contains a pepsin, a tryptase and an ereptase, each of which acts on certain substrates and possesses a definite p_H optimum for its activity. More recent work with improved technique has modified these conclusions. Brewers yeast may now be said to contain (1) a proteinase which attacks *e.g.*, de-natured egg-albumen, gelatine and peptones, the respective p_H *optima* depending on the respective substrates as well as the enzyme, but in all these particular cases it is about p_H 5.0, (2) a polypeptidase (Grassmann and Dyckerhoff 1928) which attacks polypeptides including some of those in egg-albumen peptone, p_H optimum between 7 and 8; and (3) a dipeptidase which attacks some dipeptides, *e.g.*, leucylglycine p_H *optimum* 7.8 (Willstätter and Grassmann 1926).

The Amylases or Diastases. The two enzyme theory.—The nature and number of the enzymes in the diastases of various origins are still uncertain. The opinion most generally held is that two constituent enzymes exist in most diastases, one which splits or depolymerises starch into dextrins,

and the other which produces maltose. The former is almost absent from the diastase of ungerminated barley. The latter can evidently attack starch itself without previous attack by the depolymerising enzyme, since barley diastase can convert potato starch into maltose (60 per cent.) and α amylo-dextrin (Baker, 1902). Ohlsson's work (1926) also indicates that malt extract can be deprived of either of its constituents by suitable treatment, and the saccharifying enzyme so obtained, free from the other, can attack starch. The relative activities of diastases of various origins in these two respects vary extremely. Effront (1922) states that the ratio (100 × saccharifying power) : liquefying power, varies in all from 0.1 to 2400. The ratio is also said to vary among malts of different origins. Evidence supporting the two-enzyme theory is supplied by (1) the facts embodied in the above statement by Effront, (2) the survival of the liquefying activity at temperatures at which the other activity is destroyed, (3) the work of Ohlsson (1926) on the destruction of the constituents selectively at various reactions and temperatures (the activities measured respectively by the production of reducing sugars and the loss of power of giving the iodine blue reaction) and (4) experiments on electro-dialysis and electro-osmosis is such as those of Fricka and Kaja (1924) and of Norris (1928) in which the liquefying constituent passed more readily than the other through a suitable membrane. We must remember however, that starch "liquefaction" may not be due to diastase at all, but to a phosphatase or esterase, since the conversion of the viscous constituent of starch paste (amylopectin into a mobile form seems to involve the splitting off of phosphoric acid. But even if this is not due to the diastase, there remains the depolymerising activity as distinct from the saccharifying activity.

The Theory of One Enzyme with Activators.—The actual preparation of the two constituent enzymes by, *e.g.*, adsorption methods, has not yet been achieved. Lüers and Sellner (1925) attempted this and found the ratio of liquefying power : saccharifying power to be the same in their purified preparation as in the malt extract from which it had been derived. Further, when malt diastase acts on starch at, *e.g.*, 55° C., about 20 per cent. of unfermentable "stable dextrin" remains unless the action is very prolonged. But if diastase is not destroyed by boiling and the solution is fermented by ordinary yeast, much of this dextrin is fermented away (as in a distillery fermentation), and it has been surmised that the yeast in some way assists the diastase to degrade the dextrin. The work of Pringsheim (1926) supplies some confirmation of this. By adding a preparation from autolysed yeast to a malt diastase-starch system an almost complete conversion of starch to maltose was achieved. The activator so dederived from yeast was quite specific for the purpose of rendering the stable dextrin susceptible to the diastase. All this suggests that malt diastase is the same as barley diastase plus an activator—perhaps similar to the one referred to in the yeast. The dialysis experiments mentioned above may be explained in such a way, the activator being presumably dialysable. The alternative to the two-enzyme theory is then that one enzyme exists accompanied in its natural environment by varying quantities of an activator for the depolymerising activity, and possibly another activator for the saccharifying activity. This alternative theory has much to commend it, and it adapts itself best to the view that starch is mainly composed of two constituents, amylopectin and amylose, as suggested by Maquenne and Roux and elaborated by Ling and Nanji (1923). The opinion of the present author is that the two most plausible theories are as follows :

(1) Diastases consist of varying proportions of two enzymes, in which case their actions on starch can be explained on the assumption of either a single or a dual nature of starch. The one enzyme exerts a *depolymerising* action as distinct from the *hydrolytic* action exerted by the other (compare Ohlsson, 1926).

(2) Diastases consist of one enzyme with varying proportions of an activator. In this case the dual nature of starch should be assumed. This theory would be much as follows : (*a*) The saccharifying activity is due to the enzyme itself without the activator which is specific for the amylopectin. As such, the enzyme attacks amylose destroying its power of giving the iodine reaction and transforming it into maltose. But it does not attack amylopectin, hence some iodine reaction remains and the ratio,

$$\frac{\text{Velocity of disappearance of the iodine reaction}}{\text{Velocity of appearance of reducing sugars}}$$

is relatively low. (It should be noted that barley diastase, which never quite destroys the power of the starch to give an iodine

reaction, contains very little of the activator. Ling and Nanji (1923) state that if barley diastase is exposed to alcohol for dehydration purposes, it loses altogether its power of attacking amylopectin.)

(*b*) The depolymerising activity is due to the enzyme *plus* the activator. Preparations active in this respect, but relatively free from saccharifying activity, obtained for example by dialysis, by Ohlsson's or other methods, consists of the enzyme itself, much attenuated, plus the activator in relatively high proportion, *i.e.*, almost undiminished by having passed through the dialyser, or by heat. The activator, being specific for the amylopectin, combines with or enables the enzyme to combine with and attack the latter. The maltose yield from this source is relatively low. The attenuated enzyme, having a feeble action on the amylose does not push its hydrolysis far. Hence the ratio :

$$\frac{\text{Velocity of disappearance of the iodine reaction}}{\text{Velocity of appearance of reducing sugar}}$$

is relatively high. Whilst our conceptions of the nature of the diastases may be such as these for the present, it is desirable that proper separation of the enzymes or of enzyme and activator from one another should be effected. With that a definite advance is likely to be made.

Invertase and Maltase.—Much of the recent advance in general chemistry of the enzymes referred to in the opening paragraph of this paper has been made as a result of investigations on yeast invertase. For instance, Willstätter succeeded in adsorbing the invertase of 14 kilos. of fresh brewer's yeast with 1 grm. of aluminium oxide, and the adsorbate weighed 2.5 grms. Whilst it was not possible to free invertase in any one purified preparation simultaneously from such substances as carbohydrates, phosphorus compounds, proteins and amino acids, all of which had been considered to be characteristic of pure invertase, nevertheless different preparations of high activity and stability were obtained free or almost free from any one of these It was inferred that no one of these was a necessary complement to invertase. That it was not possible to eliminate all of these classes of bodies simultaneously suggests that some kind of colloidal carrier is necessary to hold the specifically active group.

Apart from these contributions, which are of great value in the general chemistry of the enzymes, much has been done with regard to the specificity of invertase and maltase. The view of Fischer and Lindner that the alcoholic fermentation of cane sugar by yeasts consists firstly in the fission of the sugar into dextrose and lævulose by invertase, to be followed by fermentation of these hexoses, has been challenged. It has been suggested that cane sugar, maltose and lactose can be fermented directly without previous fission by invertase, maltase, and lactase, respectively. It was observed by Willstätter and Steibelt (1921) that certain yeasts which are weak in maltase are able to ferment maltose at rates which are not accounted for by the maltase content. Distillery yeasts were used (yeast M, Berlin Inst. Gärungsgewerbe, and two others from industrial sources).

Fermentation of maltose could also take place at p_H 4.5 at which reaction maltase is inactive. It was suggested that the maltase is bound up with the zymase in the cell plasma as a malto-zymase. Similarly with invertase, Willstätter and Lowry (1925), using organisms with poor inverting power, but able to ferment cane sugar, allowed them to ferment cane sugar at p_H 2, at which reaction of medium the rate of fermentation is reduced by 30 to 50 per cent., and inversion by only 6 to 14 per cent. The time required for inversion of half of the sugar ("Halbspaltungzeit") now exceeded the time required for fermentation of half of the sugar ("Halbgarzein"). The inference again, was that a direct cane sugar fermentation by a saccharo-zymase in the cell plasma takes place, and similarly in yeasts rich in invertase. However, many complications are involved, *e.g.*, the uncertain value of p_H in the cell interior in these fermentations. Yeast cell contents are probably of a reaction approximately p_H 6.0, whilst the p_H optimum of invertase is 4.2, and that of "zymase" over 6.0. In an example given above, maltose was fermented at p_H 4.5, at which reaction maltase does not function. But a p_H of 4.5 in the external medium is not necessarily accompanied by any serious alteration in p_H inside the cell, since evidence goes to show that the cell contents resist such changes. Another point is the question of inhibition of maltase and invertase by reaction products in the absence of fermentation. Such inhibition is appreciable by the time of half fission, but it would not occur if fermentation were progressing simultaneously at about the same rate and removing the reaction products. A small inhibition in the

experiments in which no fermentation occurred would easily account for the differences observed between the rates of action of these enzymes and the rates of fermentation.

It has been suggested that two types of invertase exist. In general, brewery yeast invertase is inhibited in its activity by lævulose (presumably γ fructose) but less so by dextrose. This invertase is consequently considered to combine with the lævulose half of the sugar molecule. It also splits raffinose (galactose < dextrose < > lævulose) by virtue of the same property. On the other hand, the invertase of takadiastase (from *Aspergillus Oryzae*) is inhibited by dextrose (α glucose) and combines with the dextrose part of the cane sugar molecule and splits it in that way, *i.e.*, arriving at the same result as yeast invertase in another way. The taka enzyme also splits melezitose (dextrose < lævulose < > dextrose) for the same reason, whereas yeast invertase does not. These views have been criticised by Euler and Josephson (1924 and 1926), who claim that all invertases combine with both parts of the cane sugar molecules. Kuhn and Münch, however (1925), applied the ingenious device of Michaelis and Mentone of plotting the velocity of enzyme action against the negative logarithm of the initial concentration of cane sugar (*ps*), and observed the displacement of the curve when dextrose and lævulose respectively are added to inhibit inversion. From these observations they concluded that the inhibition of yeast invertase by lævulose is due to the formation of a compound of the enzyme and lævulose, whereas the inhibition by dextrose is not due to any such cause, but to the effect of the dextrose on the rate of decomposition of the invertase-cane sugar compound. If their conclusions are correct, then two types of invertase exist, and it would be interesting to know which of them occurs in, *e.g.*, green malt. In some unpublished experiments I have found that the invertase in a yeast isolated from a Sauterne wine, resembles that of top brewer's yeast in this respect, in that it was inhibited about twice as much by lævulose as by dextrose. The same yeasts differed fundamentally in respect of their selective fermentation of dextrose and lævulose in mixtures of the two, as is well known.

A more effective criticism of the theory comes from Nelson and Anderson (1926) and Nelson and Schubert (1928) who point out the importance of water concentration when this is below 94 per cent., of which variable Michaelis' theory takes no account. Kuhn's deductions may possibly be at fault. Another interesting point of view has been put forward by Weidenhagen (1929). A useful paper on the general properties of yeast maltase by Jsaiev appeared in *The Journal of the Institute of Brewing* (1926).

Zymase. — Buchner's zymase is now known to be a complex of many enzymes, including the enzymes of esterification, hexosephosphatase, carboxylase, etc. Harden and Young's work is well known. The three fermentable hexoses, dextrose (*d.* glucose), lævulose (*d.* fructose) and *d.* mannose are fermented by yeast juice and analagous non-living yeast preparations, the rate of fermentation being accelerated by alkaline phosphates with an increased production of carbonic acid. This increase approximates to the molecular equivalent of the added phosphate. Simultaneously hexophosphates are formed, the monophosphate of Robison and the diphosphate of Harden and Young, in proportions depending partly on the type of yeast preparation employed. After the period of accelerated fermentation is over, the reaction settles down to a slow uniform rate for a considerable period.

A development of the greatest importance, due chiefly to Meyerhof (1926) has occurred in recent years. Analogous transformations of carbohydrates occur during muscular action, the fermentation product in this case being lactic acid instead of alcohol and carbonic acid. From muscle an expressed juice (analogous to yeast juice) can be prepared, or alternatively muscle extract can be precipitated by acetone (compare zymin). These preparations attack glycogen, starch (amylopectin and amylose), and tri-hexosan with the production of lactic acid. A further similarity to yeast juice consists in the presence of a co-enzyme which is dialysable and thermostable, and which is indispensable for certain stages of the reaction. The theory is that, during muscular contraction, there is some such system of reactions as the following :—

Glycogen + Inorganic Phosphate } → Labile Hexoses + Inorganic Phosphate } →
Hexosephosphate → *Lactic acid*

+ Dextrose → + Inorganic Phosphate

During recovery, between periods of muscular activity :—

Lactic Acid
+Inorganic } ⟶ Hexosephosphates ⟶
Phosphate
Glycogen.
+Inorganic Phosphate.
And Dextrose ⟶ Carbonic acid and water. The latter phase is aerobic and oxygen is necessary. If this is lacking, lactic acid accumulates with symptoms of "fatigue."

The curious fact is, however, that this muscle enzyme has very little action on dextrose, maltose and the other fermentable sugars. Such polysaccharides as glycogen are apparently broken down into "labile" hexoses which are easily esterified at the time of their formation yielding hexosephosphates, and subsequently lactic acid. But the stable hexoses are not appreciably attacked, and the enzyme loses what activity it has for this purpose very quickly, more quickly as regards dextrose than as regards lævulose. Some substance is present in yeast which is almost absent from muscle extract, since the latter possesses powers of forming hexosephosphates from labile hexoses. Some helping substance or activator is lacking from the muscle extract. These considerations led Meyerhof (1927) to seek for this activator in yeast, and he was able to prepare such from a suitable yeast autolysate by alcoholic precipitation in the cold. This activator is without apparent action on the hexoses, but, added to muscle extracts which are similarly inactive, enables the latter to promote a much more vigorous action even than that on glycogen. The activator is very sensitive to heat and to alcohol, and is not replaceable by insulin (which occurs in yeast) nor by the co-enzyme of yeast juice. The behaviour of the activated muscle extract on dextrose and lævulose in the presence of added phosphates is remarkably similar to that of yeast juice, the only essential difference being that we have lactic acid instead of alcoholic fermentation for the last stage. The similarity includes (1) the general equations representing the hexosephosphate formation, (2) the curves representing the velocity of lactic acid (or CO_2) production in the presence of different concentrations of phosphate, (3) the slow hydrolysis of hexosediphosphate after the acceleration period is over, (4) the relative rates of esterification of dextrose and lævulose. We must remember, too, that glycogen synthesis occurs in the yeast cell just as in the muscle during its recovery phase. Harden and Young (1918) obtained evidence of such a substance in the products of fermentation of both dextrose and lævulose by yeast maceration juice, and this has been confirmed by Hopkins (1928) who used zymin.

Sufficient has been said to show that there is much in common between the breakdown and general transformation of sugars by yeast juice and in muscle. It is clear that the fundamental work of Harden and his collaborators on yeast juice fermentation has led and is leading to results of great physiological importance.

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—(*From the Journal of the Institute of Brewing. April, 1930.*)

GENERAL TRADE NOTES.

PIG IRON IN CANADA.

Canada's production of Pig iron in 1929 reached the high level of 1,090,244 long tons, a record total exceeding even the output of 1,067,456 tons attained in 1918 under conditions of war-time activity. The 1,000,000 ton mark has been surpassed on only six occasions, viz. :—1929 at 1,090,244 tons; 1918 at 1,067,456 tons; 1917 at 1,045,071 tons; 1916 at 1,043,979 tons; 1928 at 1,037,535 tons; and in 1913 when 1,008,006 tons were produced .

Output of steel rose during the twelve months from 1,240,214 tons in 1928 to 1,379,688 tons last year, the large output being attributed to the continued demand for railway equipment; increasing requirements of the automobile industry; sustained activity in building and engineering construction; and the growing needs of power development and mining enterprises. Steel production in 1929 was 11 per cent. in excess of that for the previous year and no less than 52 per cent. larger than in 1927.

The Canadian Iron and Steel industry closed the year with some slackening in production, the December output of pig iron totalling 82,632 long tons, as compared with 86,516 tons in November and 103,540 tons in December 1928.

The production of steel ingots and castings in December was the lowest-tonnage reported for any month of the year, the output of 82,415 tons being 12 per cent. under the output of 93,648 tons for the previous month and 20 per cent. below the total of 103,054 tons in December 1928. The capacity of iron blast furnaces in operation in December 31st, 1029, was 60 per cent. of the total capacity in Canada. Seven furnaces were in operation with a daily capacity of 2,525 long tons. These were located as follows : 2 at Sydney, Nova Scotia; 2 at Hamilton, Ontario; 2 at Sault Ste. Marie, Ontario and 1 at Port Colborne, Ontario.

GOLD PRODUCTION IN CANADA, 1929.

According to the Dominion Bureau of Statistics at Ottawa, the figures relative to gold production in Canada last year showed a slight gain in production, but a new record value. Ontario was the principal producer, the chief sources being the Porcupine mines and the Kirkland Lake properties. While there was a slight decline in Porcupine production, a considerable increase in Kirkland Lake output more than offset the loss in the older camp. British Columbia's gold output dropped a little below that reported for 1928 but Quebec showed an appreciable increase in gold output. The Yukon, Manitoba and Nova Scotia also contributed to gold production. In order of their gold output in 1929 the leading producers in Canada were : Hollinger, Lake Shore, Tech-Hughes, McIntyre, Dome, Premier, Wright-Hargreaves and Noranda. While Canada has not yet overtaken the United States in the matter of gold output, the production of gold in these countries is gradually approaching a common level. United States production in 1929 is estimated at 2,128,027 fine ounces.

COPPER PRODUCTION IN CANADA.

Copper is now the leading metal prduced in Canada from the point of view of annual value of production. It is of interest therefore to note that the Dominion Bureau of Statistics at Ottawa reports that in 1929 the production of copper from Canadian ores for the first time reached a higher total value than the output of gold, in spite of the fact that gold production during the same year attained a record output.

The greatest gain in the year under review was in the production of copper from Quebec where the output rose 65 per cent. above the total for 1928. British Columbia was the chief producing area, the output from this province amounting to 103,937,349 pounds; Ontario's output was about 88 million pounds and Quebec added another 55.3 million pounds. Increased outputs from the Noranda Smelter in Quebec and from the International Nickel Company's properties in Ontario were the features of the year. Throughout the year prices of copper were higher than in 1928; during the first four months prices were quite strong; from May to December the price was stabilized, New York quotations being 7.775 cents per pound for electrolytic copper during this period. The average New York price for the year was 18.107 cents as against 14.570 cents in 1928.

THE MINERAL PRODUCTION OF CANADA, 1929.

We have been informed that the Acting High Commissioner for Canada in London has received from the Dominion Bureau of tatistics at Ottawa a Preliminary Report on the Mineral Production of Canada during the calendar year 1929, indicating a new high record value totalling $307,146,494, as compared with $274,989,487 in 1928.

The greatest gain was shown by the metals group, which had a total valuation of $153,694,303 as compared with $132,012,454 in 1928, an increase of 16.4 per cent. The production of fuels valued at $76,721,864 showed an increase of 3.1 per cent. and non-metallics with a total valuation of $20,698,481 a gain in value of 9.9 per cent. There was a gain of 12.65 per cent. in the production of structural materials, the total value of which was $56,031,846.

FOSTER ECONOMISERS FOR HOME AND ABROAD.

The progress which is being made in the adoption of the Foster Economiser is well indicated by the contracts placed during the first three months of this year. Installations ordered for Great Britain include the following :—

Yorkshire Electric Power Co., Thornhill, 4 steaming economisers; London Power Company, Deptford, West, 2 economisers; Sheffield Corporation Electricity Supply, 3 steaming economisers; Shoreditch Borough Electricity Supply, 1 economiser; Torquay Electricity Works, 2 economisers.

An outstanding feature of the economiser is the construction of its elements, the cast-iron gills or rings being machined and shrunk on to solid-drawn steel tubes. The apparatus is manufactured at the Wakefield Works of E. Green and Son, Ltd., for Eco Power, Ltd., London.

Proceedings and Notices of Societies

SOCIETY OF PUBLIC ANALYSTS.

An ordinary meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, April 2, the President, Dr. J. T. Dunn, being in the chair.

Certificates were read for the first time in favour of Lionel Stuart Davis, Arthur Smith, B.Sc., A.I.C., and Snow Blagburn Tallantyre, B.Sc., A.R.C.Sc., F.I.C.

Certificates were read for the second time in favour of :— Charles Ambrose Adams, B.Sc., F.I.C., Janet Warden Brown, Ph.D., A.I.C., and John Alexander Reddie, F.I.C.

The following were elected Members of the Society :— Ronald Gilbert Baskett, B.Sc., Hugh Charles Loudon Bloxam, F.I.C., Claud McClellan Bottomley, B.Sc., John Butler, B.Sc., F.I.C., Robert Ellison, A.M.C.T., George Noel Grinling, F.I.C., Albert Houlbrooke, M.Sc., A.I.C., Philip Henry Jones, F.I.C., Raymond Mallinder, Sydney Norman Herbert Stothart, B.Sc., Ph.D., A.I.C., and Hubert Threadgold, B.Sc., A.I.C.

The following papers were read and discussed :—

The Separation of Cadmium and Copper in Spelter and Zinc Ores by Internal Electrolysis. By Ella M. Collin, B.Sc., A.I.C.

The method of "internal electrolysis" devised by Sand can be used for the rapid separation of cadmium and copper in spelter and zinc ores. The most satisfactory method is to deposit the copper first from a sulphate solution containing a small excess of sulphuric acid, to dissolve the copper in excess of nitric acid, and to electrolyse the solution at 70°, when an excellent deposit is obtained. The original sulphate solutiou is readjusted with ammonia, sulphuric acid and sodium acetate, and the cadmium electrolytically deposited. The anodes are of zinc, and a 5 per cent. solution of zinc sulphate acidified with sulphuric acid is used in the anode compartments.

Routine Detection of Nitrates in Milk. By A .F. Lerrigo, B.Sc., F.I.C.

The statement of Kohn-Abrest and Kawakibi that cows' milk may contain more nitrate than drinking waters has not been confirmed, although all specimens of human milk examined gave a positive reaction for nitrates. A modification of the diphenylamine test is recommended as a rapid routine test for nitrates in milk, and has been found capable of detecting the addition of 5 per cent. of a water containing about 0.5 part of nitric nitrogen per 100,000. The test is regularly applied in Birmingham to all samples of milk containing less than 8.5 per cent. of solids-not-fat.

The Determination of Titanium as Phosphate. By J. C. Ghosh, D.Sc.

The prepared ore or clay is fused with sodium carbonate, and the mass treated with boiling water, which dissolves aluminium and silica as sodium salts, leaving sodium titanate in the residue. This is hydrolysed, and is then dissolved in either

sulphuric or hydrochloric acid, and when boiled yields a precipitate of metatitanic acid. This is dissolved, the solution just neutralised with ammonia, and the titanium precipitated and weighed as phosphate.

SOCIETY OF GLASS TECHNOLOGY.

At the meeting of the Society of Glass Technology held in Stourbridge on March 19, 1930, the following three papers were presented :—

Notes on the Manufacture of Refractory Materials in America. By G. V. RIVERS.

Several works were linked closely together in management and standardisation of sizes and shapes of goods had proceeded much further than in this country. The American firebrick works were not far ahead of us, in fact, in certain matters we were definitely leading.

The types of clay in use, and the design of the kilns were described. The excellent and accurate size and shape of the American firebrick were remarkable, whatever the refractory standard might have been. All processes except burning were cheaply performed, yet prices obtained seemed to be very high. The firebrick works plant of the St. Louis district were comparatively modern, clean, and efficient. Fuel economy in the burning process ranged from very bad to very good. In only one plant was a continuous kiln seen, the hot gases being drawn from one chamber to the next. The number of modern plants still relying on the individual kiln system was surprising. Tunnel kiln firing was being adopted in an eaborate form, the Harrop kiln being most popular for refractory articles. In the Missouri district, in particular, the manufacture of the highly refractory Diaspore brick was an outstanding feature. Glass house pots and blocks were seen in process of manufacture. The pots were made by hand, as with us, and were as thick as ours, in contrast with the German practice. Tanks, block sizes and shapes were particularly uniform and good, and were a lesson to us, but for utimate quality we had, probably, the advantage. For silica brick burning the circular independent kiln was in use except at one works.

Glass House Refractories—A Study of Corrosion Resisting Properties. By J. H. PARTRIDGE AND H. C. BIGGS. (A communication from the Research Laboratories of the General Electric Company, Ltd., Wem-

Dr. Partridge showed that it was very desirable to obtain a method of measuring rapidly and quantitatively the corrosion resisting properties of refractory materials with a view to correlating the results of laboratory tests with those of actual service. The test proposed by Mr. E. J. C. Bowmaker (*J. Soc. Glass Tech.*, 1929, 13, 130), had been utilised in this newer work, and had become part of the laboratory routine work on tank blocks. This test was applied to a number of samples of tank blocks some of which had been tested in actual practice. The results obtained in the acid corrosion test classified the blocks in the same relative order as their behaviour in practice. Particulars of texture percentage chemical composition, firing, and crystalline constitution of the samples were given together with the percentage loss in weight in the acid corrosion test, and the true and apparent porosities. Tests were made on samples as received, and after refiring to 1450° for 5 hours. A study of the results showed that :—

(*a*) An improvement in resistance to acid corrosion was, in all cases, effected by refiring to 1450°.

(*b*) The greater the alumina content the greater the resistance to corrosion, and

(*c*) Low true porosity was beneficial and should not exceed 2.0 per cent.

Tests on sillimanite showed that th character of the bond was a vital factor. No only must sillimanite be fired to 1450°, bu the choice and amount of bonding materia were of great importance. Application o the acid corrosion test to pot-clay mixture revealed that this test did not differentiat readily between the mixtures. The resist ance to corrosion of the pot-clays was les than that of the good tank blocks examined

Some Practical Results with Sillimanite Glass House Refractories. By L. C. GOUGI

Difficulties met with in the early stages c the production of sillimanite pots were de scribed, these appearing to be due largely t the use of an unsuitable clay as a bond. I only isolated cases had sillimanite pots prc duced stones in glass, and later results ir dicated that a more suitable clay bond wa now in use. Higher temperatures of firin were also now applied and hopes were hel out for a more satisfactory pot. Pot-ring had remained in glass for ten or mor weeks, and given satisfactory service, bu observations proved that, until the ring wa sufficiently cheap to be used for one wee only, to meet the custom of the gla

workers, the use of such rings would not be extensive. It was hoped that the cheap rings would soon be available. Sillimanite sieges in pot furnaces were now common; in either the "rammed" or the block form. Sillimanite tank blocks had given very good results in the dog-house, as mantle blocks over the dog house, and on the flux line. Used in ports, the verdict had been variable. Samples were shown of blocks which had been used in a tank lining for twelve months, double the life of clay blocks in this furnace. It was recommended that the sillimanite content of blocks should not be too high owing to the difficulties of bonding. Results obtained on feeder parts were not in agreement, but this was attributed to differences in firing between the brick works concerned. Repairs executed with sillimanite cements to crowns of furnaces were reported as satisfactory, and pyrometer tubes were now on the market.

ROYAL INSTITUTION.

A General Meeting of the Members of the Royal Institution was held in the afternoon of April 7, Sir Robert Robertson, Treasurer and Vice-President, in the chair. The chairman announced that Dr. G. S. Newth had presented the spectacles worn by Faraday when carrying out his researches on Glass. Miss Elizabeth Block, Sir James Devonshire, Sir Guy Granet, Mr. Norman Hart and Mrs. Gerta Schubeler were elected Members.

A FORTHCOMING BOOK.

Mr. Julius Grant, Ph.D., M.Sc., A.I.C., has written *The Measurement of Hydrogen ion Concentration*, which will shortly be published by Messrs. Longmans.

The widespread and increasing importance of this subject has rendered a study of it essential to students and to numerous workers in branches of science and industry, which do not otherwise demand a knowledge of the fundamental theoretical and practical principles on which it is based. There is, therefore a definite need for a book which provides simple but adequate explanation of the theoretical side of the subject, together with detailed instructions for the actual measurements.

Parts 1, 2, and 3 deal with theory and with the electrometric and colorimetric methods, respectively. The procedures and apparatus described are those which experience has shown to be simple but reliable, and special care has been devoted to pitfalls which may trap the inexperienced worker. Part 4, a novel feature, deals with methods and technique suitable for particular problems such as may arise in connection with Agriculture, Analysis, Biology, Dyestuffs, Fermentation, Food, Leather and Paper Industries, Pharmacy, Metallurgy, Water, etc. Finally, the most recent and reliable data required have been summarised for rapid reference in Part 5. Numerous classified references to original papers have been carefully selected for the research worker, or for those who wish to make a further study of any branch of the subject.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery

Latest Patent Applications.

9,357.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of ammonium carbonate. March 24.

9,362.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of aluminium salts of oxalic acids. March 24.

9,364.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of azo dyestuffs. March 24.

9,678.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of pure anhydrous aluminium chloride. March 26.

9,958.—Imperial Chemical Industries, Ltd., Loveluck, R. J.—Production of phthalic acid derivatives. March 28.

Specifications Published.

326,791.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of dis- and poly-azo dyestuffs.

301,311.—I. G. Farbenindustrie Akt.-Ges. Manufacture of halogen-naphthalene-ketones.

326,815.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of sulphonic acids derived from non-aromatic carboxylic acids.

302,912.—Ges. fur Teerverwertung, and Kaffer, Dr. H.—*Carrying out catalytic hydrogenation.*

326,865.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of mixed ethers of carbohydrates.

Abstract Published.

324, 935.—Carboxylic acids. — Drescher, H. A. E., Fairweather, D. A. W., Thomas, J., and Scottish Dyes, Ltd., Earl's Road, Grangemouth.

Carboxylic acids are obtained by heating together for a short time an alkaline earth metal salt of a diarylketone carboxylic acid and an alkaline earth metal oxide or hydroxide. Substituted ketone carboxylic acids *may be used for the production of substituted carboxylic acids. In examples* a-naphthoyl-o-benzoic acid yields a-naphthoic and benzoic acids, and o-benzoylbenzoic acid yields two molecules of benzoic acid. Specification 289,544 is referred to.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

CHROMILITE.

507,472.—Chemical substances used in chromium plating. — The Metals Protection Corporation, 401, West Michigan Street, Indianapolis, County of Marion, State of Indiana, United States of America. April 2. (Associated.)

SULSOL.

*509,305.—Colloidal sulphur being a chemi*cal substance for use in manufactures.—Einstein's Electro Chemical Process, Ltd., Cockpit House, 38, Old Queen Street, Westminster, London, S.W.1. April 2.

SOLV-O-HOL.

510,811.—Chemical substances used as solvents in the manufacture of flavourings and perfumery.—Felton Chemical Co., Inc., 599, Johnson Avenue, Brooklyn, New York, United States of America. April 2.

TAIL-WAGGER.

509, 518.—Chemical substances used for veterinary purposes. — Spratt's Patent, Ltd., 24 & 25, Fenchurch Street, London, E.C.3. April 2. (Associated.)

A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

The recent revival of interest in history of the Sciences makes the b appeal to the general scientific public. is also intended for use in Schools, where History of Science occupies a place in curriculum.

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THE PROBLEM OF PREPARING OPTICALLY ACTIVE FREE RADICALS.

In the *Proceedings of the National Academy of Sciences of U.S.A.* (1930, *16*, 215-218) Everett S. Wallis communuicated a paper on the above problem of which the following is a very slightly abbreviated account—practically the complete paper.

In investigating the Beckmann rearrangement Jones and Wallis (*Journ. Am. Chem. Soc.*, 1926, *48*, 169-) studied the nature of the products formed by the rearrangement of certain optically active acid azides, and optically active hydroxamic acids. The one, *d*-benzylmethylacetazide, $C_7H_7(CH_3)HCCON_3$, was found to give on rearrangement an optically active isocyanate, $C_7H_7(CH_3)HCNCO$, that could be converted into an optically active amine hydrochloride and by treatment with aniline into an optically active monosubstituted urea. These experiments and other known properties of optically active compounds led them to suggest that it was very probable that in the rearrangement of the optically active radical if existing as a free radical, did so in such a way as to maintain a configuration required to produce an optically active rearrangement product; that is, it was a positive radical of the nature of a carbonium ion, and that its its wandering from the carbon atom to the nitrogen atom it leaves behind the electron which it shared with the carbon atom.

These investigations suggested to the author two problems :—

1.—A study of the Beckmann rearrangement in the presence of free radicals.
2.—The possibility of preparing an optically active free radical.

The results obtained from a study of the first problem have been published (Wallis, *Journ. Am. Chem. Soc.*, 1929, *50*, 2982).

The investigations which of necessity had to be carried out before the answer could be given to the second problem are given here.

The first step in the preparation of an optically active free radical involves the preparation of certain derivatives of an optically active tertiary carbinol, and since derivatives of tertialy carbinols of the aliphatic series do not form free radicals, the choice is limited to tertiary carbinols of the aromatic series containing an asymmetric carbon atom. Literature shows that no derivations of tertiary carbinols of this type have been resolved. Methods of resolution of these compounds should be of interest.

For these investigations phenylbiphenyl-α-naptnyl carbinol, $C_6H_5(C_6H_5C_6H_4)(C_{10}H_7)$-COH. This carbinol in the form of its chloride was prepared by the method of Schlenk (*Annalen*, 394, 196-) and had a melting point of 196.5—197°C. The carbinol was also prepared and melted at 162°C.

Attempts were made to resolve the carbinol itself by combining it directly with brucine, quinine, camphor sulphonic acid, etc., but only with negative results.

Attempts to make the carbinol, in the form of its chloride, to combine with silver salts of optically active acids was without satisfactory results. Attempts to prepare the half ester of phthalic acid and the carbinal also failed so that such resolution with an alkaloid could not be used. The chloride did combine with the sodium salt of optically active amyl alcohol as was first reported by Schmidlin (*Ber.*, 1912, 45, 3188-), but fractional crystallisation gave only a very small amount of the optically active amyl ether and this was abandoned.

Phenylbiphenyl-α-naphthylchloromethane however, was found to combine with thioglycolic acid according to the equation :—

$C_6H_5(C_6H_5C_6H_4(C_{10}H_7)CCl + HSCH_2OOH \rightarrow HCl + C_6H_5(C_6H_5C_6H_4)(C_{10}H_7)C\text{-}SCH_2\text{-}COOH$,

giving a stable thioglycollic acid derivative which combined with brucine acid and was easily resolved, giving the thioglycollic acid derivative of the optically active tertiary combinol.

Preparation of d-l Phenylbiphenyl-α-naphthylmethylthioglycollic Acid. — C_6H_5-$(C_6H_5C_6H_4)(C_{10}H_7)C\text{-}SCH_2COOH$. 10,90g. of thioglycollic acid were refluxed with 47.8 g. phenylbiphenyl-α-naphthylchloromethane in 100 cc. of dry toluene. The reaction began at a temperature of about 70°C., and hydrogen chloride gas came off as the by-product of the reaction. After the end of the reaction, which usually took about one hour, the solution was allowed to cool, and the white cystalline precipitate that separated was collected at the pump. This was washed with petrol ether, and after two crystallisations from hot toluene gave a white cyrstalline material which contaiend one molecule of toluene of crystallisation and melted sharply at 116-116.5°C. Yield, 51g. Analysis for S, Carius method : 0.2006g. of substnace gave 0.0851g. $BaSO_4$. Calc.S, 5.79 per cent. Found, 5.82 per cent.

Resolution of Phenylbiphenyl-α-naphthylmethylthioglycollic Acid.—85g. of the racemic material were dissolved in 200 cc. of dry acetone and added while still warm to 90g. of brucine suspended in 400 cc. of acetone. Solution took place immediately. The mixture was filtered, and allowed to cool overnight without stirring. A large amount of a white material separated. This was collected at the pump, and fractionally crystallised from hot chloroform petrol ether solution. After four crystallisations no further change in the optical activity or the melting point of the solid could be detected. 40g. of brucine salt were obtained which melted sharply at 215°C.

1.2124g. of this material dissolved in 25 cc. of chloroform solution gave a rotation of -1.64 in a 2-dc. tube at 20° C. $[\alpha]^{20}_D = -16.91$.

Preparation of l-Phenylbiphenyl-α-naphthylmethylglucollic Acid.—39g. of the brucine salt were suspended in ether and decomposed with dilute sulphuric acid. The ether layer was washed free from the sulphate ion and then dried with anhydrous sodium sulphate. This solution was concentrated to about 150 cc. and the acid slowly precipitated by addition to petrol ether. The white material which precipitated was collected at the pump and recrystallised from warm toluene-petrol ether solution. The dry product melted at 109-110°C.

1.0242g. dissolved in 25 cc. of dry ether solution gave a rotation of -1.06 at 25°C. in a 2-dc. tube. $[\alpha]^{25}_D = -12.93°$.

1.002g. dissolved in 25 cc. of carbon tetrachloride solution gave a rotation of -1.09 at 20°C. in a 2-dc. tube $[\alpha]^{20}_D = -13.63°$.

Analysis for S by Carius method. 0.1412 g. of substance gave 0.0722g. $BaSO_4$. Calc. S, 6.95 per cent. Found, 6.90 per cent.

Conclusions.—A method of resolution of tertiary carbinols of the aromatic series containing an asymmetric carbon atom has been described by means of which an optically active derivative of phenylbiphenyl-α-napthyl carbinol has been prepared. Investigations are now in progress with a view of converting this compound into an optically active triarymethyl. The results of these experiments will be reported at a later date and should be of interest not only in connection with the Beckmann rearrangement but also should contribute further valuable information on such important questions as the Walden Inveision and the constitution of the triaryl methyls in general.

ÆTHER DRIFT EXPERIMENT.

Professor Dayton C. Miller has repeated his Mount-Wilson Æther Drift Experiments during the past year and he still gets a definite indication of the movement of the solar system towards what may be regarded as a fixed region in space. Further particulars are awaited with interest.

N INTERPRETATION OF PAULI'S EXCLUSION PRINCIPLE.

Atomic physics has grown to rather :midable dimensions in the hands of the athematicians now provided with an undance of experimental material to work on.

Certain principles have been brought into ing which help to make clear the complex 1eme of affairs, referring mainly to spec- oscopic work.

In the *Physical Review*, (1930, 35, 579- 2) E. U. Condon and J. E. Mack (National esearch Fellow) present an interesting per as titled above, their abstract being— I. Pauli's exclusion principle can be derstood as an instance of the subjec- ity of our knowledge. We are built out only a particular world constructed ac- rding to one of the non-combining pat- rns possible under the laws of quantum echanics. Therefore we are capable of ving sense perceptions of only that world. II. Dirac's theory of the proton shows w Pauli's principle governs the world.

Philosophy in the metaphysical sense ems to have entered the sacred precincts pure science, for here we have the pression: *objective reality*. Our science ves no information about an objective ality wholly indeoendent, of ourselves, to e the above authors' words, as will be rgely done in the matter that follows here. 1e subjectivity of our knowledge is be- ming a feature in the efforts to interpret ienomena, and Bridgman has emphasised e unprofitableness of dallying over eaningless questions, for they are to be nsidered in the light of a wider and more arching method of analysis that brings me the question of objective reality in nnection with our mode of interpretation. idgmau's operational formulation of the ality of physical concepts is to be reckoned ith. The rôle played by our subjective nitations on observational matters of the orld has been discussed in detail by eisenberg and by Bohr, referring here to e train of ideas known as *Heisenberg's certainty principle.*

Before the uncertainty principle was pro- unded quantum mechanics was definitely ated by Heisenberg, Born, Dirac, Jordan, hrödinger, Pauli and others. There was completeness about these statements that ade them workable and acceptable in the nds of physicists, and it was when these rmal laws were still in the process of be- ming common property that Heisenberg enunciated his *uncertainty principle* in the *Zeitschrift für Physik* (1927, 43, 3-4). This principle cleared the way to a better under- standing of the laws, and may be stated thus :— *Exact definitions of place, velocity, energy, etc., as applied to electrons can only be determined simultaneously with charac- teristic inexactness.* As Eddington has said (The Nature of the Physical World, 1928, page 220—see also page 306), *a parti- cle may have position or it may have velocity, but it cannot in any exact sense have both.* Eddington calls it the *principle of indeterminacy.*

There is another empirical law of nature intimately connected with quantum mech- anics, that affords elucidation, this being *Pauli's exclusion principle.* This principle grew out of empirical spectroscopy and was stated in the form *that no two electrons in an atom can have the same set of quantum numbers.* This principle occupies a formal place in the equations of quantum mechanics of Heisenberg, Dirac, Wagner and others. It is believed that all electrons are dyna- mically similar, and this is of fundamental significance in the mechanism of nature. The equations of quantum mechanics showed a remarkable property when applied to the description of a dynamical system consisting of several dynamically similar particles. Since the electrons are dynamic- ally similar this remarkable property may be described by saying that such dynamical systems may exist in $N!$ different classes of states such that if the system exists now in one of these classes then it must exist for all time to come in this srame class of states, to use here the exact words of the authors. N is the number of similar particles in the system. *In other words, quantum mech- anics provides*, when applied to the dynami- cal system which is the entire universe, not jnst one solution, but $N!$ possible solutions, which we may call *worlds*, where N is the total number of electrons in the universe. Since it is an exact conclusion from the postulated exact similarity of all the parti- cles that the universe cannot change from one of these classes of states to auother our universe must represent a selection from among these possible worlds. Which one? There is one, having the property, as stated above, that it has no possible states charac- terised by two of the particles having the same quantum numbers. That one agrees with the world known to us.

This is interesting, but it leaves out of account the other possible worlds, namely $N!-1$.

Coming now to the authors' main thesis; The restriction to a world built in accordance with Pauli's principle can be understood as another and extreme instance of the subjectivity of our knowledge. We can only react with, and have sense perceptions of, a particular world constructed according to a particular one of the non-combining patterns possible under the laws of quantum mechanics. Because of our own nature we are aware or unconscious of, only that part of possible reality that is built to our pattern.

Do worlds exist which are built on other patterns but still according to the laws of quantum mechanics? The question is meaningless because of our subjective incapacity to be aware of them. It is meaningless for the same reason as the question sometimes asked about the uncertainty principle (see above). "Does a particle really have precise position and momentum simultaneously even though we cannot be experimentally aware of precise values for them?" Here the situation turns on the meaning to be ascribed to the word *really*. The answer is No in both cases.

Thus it is that we can be conscious of only one of the possible worlds. The authors here discuss possibilities, finishing with the words: But in the matter of building the real world the dice are cast but once and in that one throw the antisymmetric pattern has an equal chance with the others.

Dirac's recent theory of the proton published in the *Proceedings of the Royal Society*, 1930, *A*,*126*, 360-365, throws new light on the matter. In speaking above of there being $N!$ different possible worlds, according to quantum mechanics, we were speaking of the non-relativistic theory; but this theory applied to the electron must represent a surer foundation on which to build hypotheses. Accordingly, electrons can exist in states of negative energy (less than $-mc^2$), as well as in usual states of positive energy (of the order of $+mc^2$). We have no experimental evidence of electrons of this sort, and so the prediction of negative energy electrons was regarded as a blemish in the theory; but now the solution of the difficulty is seen in the fact that Pauli's principle governs *our* world. This is made more evident by the following quotation of a paragraph in Dirac's paper:—"The most stable states for an electron (*i.e.*, the states of lowest energy) are those with negative energy and very high velocity. All the electrons in the world will tend to fall into these states with emission of radiation. The Pauli exclusion principle, however, will come into play and prevent more than one electron going into any one state. Let us assume that there are so many electrons in the world that all the most stable states are occupied; or, more accurately, that *all the states of negative energy are occupied except perhaps a few of small velocity.* Any electrons with positive energy will now have very little chance of jumping into negative-energy states and will therefore behave as electrons are observed to behave in the laboratory. We shall have an infinite number of electrons in negative-energy states, and indeed an infinite number per unit volume all over the world, but if their distribution is exactly uniform we should expect them to be completely unobservable. *Only the small departures from exact uniformity, brought about by some of the negative-energy states being unoccupied, can we hope to observe.*"

Thus it is that the Pauli-principle world is the only one that can be built out of Dirac's relativistic electrons. For it is one in which the available states can be filled up. For all others there is no limit to the number of electrons which can occupy a state. The antisymmetric one is the only pattern that has a "bottom." For the others all the electrons in the universe would be drained off into states of indefinitely great negative energy.

To improve the appearance of the text the present writer has not inserted quotation marks in many passages taken from the original. Here and there a little explanatory matter or amplification has been added.

F. H. L.

THE TWO-ELECTRON PROBLEM — SEPARATION ANGLES IN CONNECTION THEREWITH.

In the *Physical Review* (1930, *35*, 569-578) G. Breit investigates the above problem, the abstract of his paper being:—"Neglecting the spin, two electrons are described in quantum mechanics by means of a wave equation in six variables. It is shown that well-known relations between angular momentum operators make it possible to determine the dependence of the wave function on three variables. The problem is thus reduced from *six* to *three* dimensions. For a state with an assigned 'orbital angular momentum l, say, an S, P, D state the dependence of the wave function on three Euler angles is determined by th

value of l. The wave function is a linear combination of products of distance and angle functions, the latter depending only on the three Euler angles. The angle functions are well-known solutions of the wave equation for a symmetrical top. The distance functions satisfy wave equations in three variables r_1, r_2, r_{12} or r_1, r_2 θ. The case of P terms is worked out in detail. Equations (10), (25) apply to two electrons having the same azimuthal quantum number. Equations (18), (20), (24) describe all the other cases, for instance S and P electrons combining to give $1P$ and $3P$. Triplets are described by (18) and singlets by (20)."

This paper is of the usual mathematical kind necessary to the subject and it has an appendix also mathematical. Being possibly an important paper attention is drawn to it in these columns.

THE VALUE OF THE FARADAY.

R. T. Birge (*Phy. Rev. Sup.*, 1929, *1*, 1-73) in his very complete paper on the physical constants, discusses at length the precise value of the Faraday (F); this, of course, being the quantity of electricity carried in electrolysis by one gram equivalent of any element.

Each univalent ion carries a charge of electricity numerically equal to the charge of the electron (e).

The number of atoms or molecules in one gram equivalent is taken as the Avogadro number (N), so that $F = Ne$. N is thus evaluated from F and e. Furthermore, the electrochemical equivalent (E) of a substance is the mass associated with unit charge. The usual electrochemical equivalent taken is that of silver (E_{ag}) which is 0.0011180, so that $Ag/0.0011180 = F$ in international coulombs. Ag = atomic weight of silver = 107.880 ± 0.001.

If the above be expressed in *absolute* coulombs then a correction (q) has to be applied, that is to say the atomic weight of silver has to be multiplied by q, which is 0.99995 ± 0.0005. This correction does not make much difference in the result, but introducing it gives the value for $F = 96489$ abs. coul. This arises from the international ampere being a little high, so that it has to be multiplied by 0.99995 ± 0.0005. This error is so small that it might be taken to be swallowed up by other errors in the other quantities.

In fact, Vinal, Bates, Bouvard, Rosa and McDaniel (see the following papers :—G. W. Vinal and S. J. Bates *Bur. Stand. Bull.*, 1914, *10*, 425; E. B. Rosa, G. W. Vinal, and A. S. McDaniel, *ibid*, p.475; G. W. Vinal and W. M. Bouvard, *ibid*, 1916, *13*, 147) seem to advocate the value for F as 96500 in international coulombs, or 9650 when using electromagnetic units. Ignoring the fine correction above, if this value be taken then the value of E_{ag} is 0.0001117927 in E. M. GRAM UNITS..

Since the gram equivalent of silver just given is experimentally determined the possible errors in measnrement have to be considered. Birge discusses this (*loc. cit.*). It appears that there may be some "inclusions" which would raise the value by measurement. Whether any silver can be mechanically carried over is not mentioned; but at any rate, the value is not absolute and the difference between the value computed from " 96500 " and the atomic weight of silver above given is perhaps within experimental error.

This note may be read in connection with one by the undersigned in this journal on page 242 of this volume.—F.H.L.

FURTHER OBSERVATIONS ON THE PHYSICAL CONSTANTS.

If Olfin's value for h (see *Chemical News*, 1930, *140*, 244, where an abstract of Olfin's paper is given), 6.541×10^{-27}, be taken with the current value of c (2.99796×10^{10}), and Eddington's value 137 (see *Chemical News*, 1930, *140*, 211), then from the equation $hc/2\pi e^2 = 137$ exactly, e comes out at 4.773×10^{-10}. If the Faraday, F, be taken as 96500 (see *Chemical News*, 1930, *140*, 243), then Avogadro's number comes out at 6.06124×10^{23}.

Bearden's experiment introduces a disturbing factor however (see *Chemical News*, 1930, *140*, 211), as it makes e and h higher than above whilst making Avogadro's number lower.

A new determination of e/m_0 by F. Kirchner (*Phys. Zeit.*, 1929, *30*, 773-777) gives the value 1.770×10^7. This does not support Birge's value, 1.7611×10^7 (spectroscopic), but supports Wolf's deflection value, 1.769×10^7, closely. The present writer's value, using Eddington's " 137 " falls between these two higher values (see *Chemical News*, 1930, *140*, 178).

It seems probable that the 'Bearden values' for h and e are too high. If they are reduced slightly and a mean be taken of all the values in question in each case, they would come out close to the present writer's values, respectively, 6.55666, and 4.7786, neglecting here the multipliers. This is when using Eddington's 137 exactly, as explained in the *Chemical News* (*loc.*

cit.). This is not, obviously, a deduction that a trained computer would tolerate, but it does represent a general view in so far that Bearden's values, so called, are high, and yet they should not reduce to those of Birge.

A new determination of the velocity of light by O. Mittlestaedt (*Ann. d. Phys.*, 1929, 285-312) though of great interest owing to a newer method used with greater refinements than hitherto by the same method, does not displace the value of Michelson, practically used throughout these studies, as Mittelstaedt's value is 299778 ± 20 km. per sec.

From the discussions in these columns, and particularly the papers referred to therein, the reader will be able to form a pretty good opinion of the present status of some of the leading physical constants; but, as Birge has said at the conclusion of his classic paper, referred to several times in these studies, "it must be admitted that this is a very unsatisfactory way to leave the situation in the case of the most important constants known to science." Here Birge is referring to the higher values of h and e as Eddington's "136" involved, and also the work of Bearden in this connection. 136 is now 137, but Bearden's precision X-ray measurements leave the matter unsettled as already discussed in these columns.

When one stops to think of the enormous labour and the highest order of technique involved in determining some of these physical constants, to write about them, as the present author has done, represents work not worthy to be mentioned in the same category. If, however, the readers' interest can be excited then something will have been accomplished.

F. H. L.

THE PROBABILITY LAW FOR THE DECOMPOSITION OF RADIOACTIVE MATERIALS IN VERY SMALL CONCENTRATIONS.

G. I. Pokrovski (*Zeit. Physik*, 1929, *58*, 706-709) in a paper titled as above finds that for very small concentrations of radioactive material there are α-ray derivations from the probability law. This seems to indicate that the spontaneous decomposition of the atom is not independent of neighbouring atoms.

The present writer in this Journal (1928, *137*, page 37) had made the following observation :—"This means that if there were no planets, or their equivalent, there would be no sunspots, and—going back to the origins of the planets—therefore, the original 'explosions' could not have taken place if there had been no passing star. If now this idea is extended to the radioactive atoms, a single isolated atomic nucleus, however large or massive, could not be radioactive. What is the external mechanism in this case? Magnetism seems to involve a similar idea, for it is *atomic* yet strongly influenced by the molecular state, or state of aggregation. To picture the idea that comes to mind in these matters, particularly the sun spots, it is as if the planets caused a winding up of a spring which unwound spasmodically (at intervals), this being the trigger mechanism."

Incidentally, in this same paper the present writer computed the period of a planet beyond Neptune as being 316 years. The newly-discovered Trans-Neptunian planet is reported as having a period a little over 300 years.

It is of interest, whether these findings turn out to be as first indicated or not, to consider ideas perhaps a little off the beaten track, but he who *demonstrates* deserves the reward.—F. H. LORING.

THE QUANTUM THEORY OF X-RAY EXPOSURES ON PHOTOGRAPHIC PLATES: ALSO THEORIES OF THE SOLARISED LATENT IMAGE.

In *The Physical Review* (1930, *35*, 662) there is an abstract of a paper, read before the American Physical Society, by A. P. H. Trivelli. The quantum theory of photographic exposures as proposed in 1922 by L. Silberstein had to be given up on account of the fact that the differences in sensitivity of the grains are determined not only by the projective area of the grain, but by a chemical factor also entering into the problem for visible radiation. Kinoshita and Th. Svedberg have shown that every α-particle hitting a silver halide grain makes it developable. The sensitivity of the grain is, therefore, determined by its projective area; and the probability that a grain is made developable by exposure to α-particles is given accurately by the equation,

$$p = 1 - \exp - na,$$

a being the projection area and n the number of α-particles. An investigation with L. Silberstein has shown that the same equation holds for X-ray exposures.

In the *Journal of the Franklin Institute* (1930, *209*, 373-389) the above author contributes a long article on the solarised latent image of photographic emulsions, which is summarised as follows :—

1.—A general discussion is given of the main theories proposed to explain solarisation as a development and as a latent image problem.

2.—A critical investigation leads to the rejection of the progression theory of coagulation of the latent-image silver by prolonged exposures, and the acceptance of the regression theory.

3.—*The regression theory is applied to* the concentration-speck theory, which leads to a tentative hypothesis of the solarised latent image.

4.—Lüppo-Cramer's explanation of solarisation holds for X-rays.

These papers should be of interest to those investigating the difficult problem of the photographic plate. In the latter paper there are about 100 references, but there is no mathematics.

AN ANALYSIS OF THE ULTRA-VIOLET BAND SPECTRUM OF THE SODIUM-POTASSIUM MOLECULE.

By Yoichi Uchida.

The existence of the sodium-potassium compound in the vapour state has been shown by Barratt (*Proc. Roy. Soc.*, 1924, *A 105*, 221-). In this study of the absorption spectrum of a mixture of Na and K vapours, sixteen band-heads lying in the *region between* $\lambda 5955$ *and* $\lambda 5645A$ *were* measured on his plate. Pringsheim (*Zeit.* compound in the vapour state has been *f. Phys.*, 1926, *39*, 161) and Pringsheim and Rosen (*Zeit. f. Phys.*, 1927, *43*, 521-) have confirmed the above result by obtaining this band-system in fluorescence.

Recently in the course of their investigation on the spectra of vapours of alkali metals and of their alloys, Walter and Barratt (*Proc. Roy. Soc.*, 1928, *A 119*, 257) have found a new system of the absorption bands due to Na-K vapour in the ultra-violet region. The wave-numbers of 70 band-heads with their intensities are given, but their quantum numbers are not assigned.

The following is the author's abstract of his paper of 8 pages in the *Japanese Journal of Physics*, 1929, *4* :— The ultra-violet absorption band spectrum of Na-K molecule measured by Walter and Barratt was analysed, certain vibrational quantum numbers being assigned to the bands heads. The correctness of this analysis was tested by comparing the intensity distribution among the heads with Condon's parabola calculated from the molecular constants of Na-K. The analysis indicates that the molecular constants have values intermediate between those of Na_2 and K_2. The heats of dissociation of the Na-K molecule in the upper and lower states for the ultra-violet bands were found to be about 0.75 and 1.4 V. respectively; this shows that on *absorbing the light in these bands* a Na-K molecule dissociates into a Na-atom in the normal state 3^2S, and that a K-atom is in a certain excited state (5^2S or 3^2D which could not be decided from the present analysis).

THE RIPENING OF BANANAS.

General.

In 1928, the Council decided to undertake work on the maturation of bananas, and a committee was appointed to control this work. This now consists of Mr. W. Ranger, B.Sc., Manager, Committee of Direction of Fruit Marketing, Queensland (Chairman), Dr. L. S. Bagster, Lecturer iu Applied Chemistry, University of Queensland, Dr. W. J. Young, Associate Professor of Biochemistry, University of Melbourne, and Mr. G. Williams, Director of Fruit Culture, Department of Agriculture and Stock, Queensland.

By permission of the two Universities, experimental ripening rooms were erected, one set at the University of Queensland, under the direction of Dr. Bagster, the other at the University of Melbourne, under Dr. Young. Mr. F. E. Huelin, B.Sc., and Mr. E. W. Hicks, B.Sc., were appointed by the Council as assistants for the work in Brisbane and Melbourne, respectively.

Experimental work was commenced in Brisbane early in February, 1929, and in Melbourne at the end of March, 1929, whilst check experiments have been conducted in a small commercial ripening room on the premises of the Committee of Direction in Brisbane.

The experimental work is not yet completed, but it seems desirable at this stage to indicate to the commereial ripeners of Australia what progress had been made, and what would appear to be a satisfactory commercial procedure based on such experimental work.

Factors Concerned in Ripening.

The Effects of Coal Gas in Ripening.—In the course of the investigation it was found that the presence of coal gas in the atmosphere exerted a very marked action upon the ripening of bananas.

Not only does coal gas accelerate the ripening of bananas very considerably, but it has a marked effect in producing uniform ripening throughout the bunch or the case. Under ordinary ripening methods, some bananas are frequently much behind others. The addition of coal gas results in the ripening of such bananas being hastened considerably. Bananas ripened under this process are of excellent colour and flavour, and maintain their condition for a considerable time. The effect of this gas is especially marked with immature bananas.

Ethylene.—It has long been known that ethylene exercises a marked effect in accelerating colour change in the ripening of various fruits and vegetables, and a good deal of work in this connection has been done in the United States of America. Ethylene, however, is fairly expensive, and not always easy to procure. The coal gas method is apparently more practical for use in Australia. Ethylene, of course, is a usual constituent of coal gas, being present in small quantities, and it is possible that it is solely responsible for the accelerated ripening. The quantity present in the amount of coal gas used, however, is so very small compared to the proportion found effective in the United States, that it is possible that other constituents also may contribute to the effect. Active search is now being made to discover just what is the real cause of the accelerated ripening, whether it be through ethylene, carbon monoxide, or any other constituent that may be present in coal gas.

Accurate Dosage of Coal Gas Necessary.—The addition of too much coal gas, or the application of too high a temperature results in undue softening of the fruit, and produces an unsatisfactory article of very poor appearance, and the quantity of coal gas suggested below should be strictly observed.

Time Required in Ripening.—During the winter months it was found that the reduction of humidity and the change to constant ventilation was necessary some time during the fourth day. In about another 24 hours the bananas would be sufficiently "hardened off" for country trade.

Actual Commercial Tests.—Tests made on a commercial scale by sending fruit to country centres in Queensland resulted in many letters of approval and requests for a continuous trade in such fruit. Definite increases in sales were reported as a direct result of the improved quality of the bananas ripened under the method outlined.

Effect of Light.—It is possible that absence of light may prove a factor in developing a satisfactory colour. This point is n fully established, and is only mentioned indicate the lines upon which the research proceeding.

FURTHER WORK.

It is expected that a complete report of t investigating committee will be available i a few months, when suggestions for proce ure and for construction of rooms will be o fered in more detail. Meanwhile, the follov ing suggestions are put forward tentativel together with a description of applianc and methods by which the conditions ma be attained. Any queries will be gladl answered if addressed to members of the i vestigating committee, either through th ouncil for Scientific and Industrial Researc or directly.

SUGGESTED PROCEDURE.

1. *Treatment until bananas begin t change colour.*
   - (a) Keep temperature at 68 deg. F
   - (b) Maintain a relative humidit (moisture content) of 85 to 9 per cent. (i.e., the wet bulb c the wet and dry bulb thermom eter should register about 6 deg. F.).
   - (c) Use no ventilation, but keep th air in the rooms in constan motion by a fan.
   - (d) *Add to each room, night an morning, coal gas in the propor tion of one part to 2,000 part of air.*
2. *When bananas begin to change colour*
   - (a) Maintain the temperature at 6 deg. F., or reduce a few degree if it is desired to retard the rip ening process, but cease addi tion of coal gas.
   - (b) Reduce the relative humidity t at least 70 per cent. (i.e., we bulb temperature of not mor than 62 deg. F. if the room tem perature is kept at 68 deg. F.).
   - (c) Ventilate freely by means of a fan.

[The above is taken from the *Australian Journal of the Council for Scientific and Industrial Research*—1929.]

Trade Developments and Problems

BRITISH CHAMBERS OF COMMERCE.

Speech by Mr. G. M. Gillett, M.P., Secretary of the Department of Overseas Trade, on the occasion of the Annual Meeting of the Association of British Chambers of Commerce—April 10th, 1930.

Overseas Trade of the United Kingdom.

If we look upon the countries of the world as importers of United Kingdom manufactures we see that our share is declining while that of some of our competitors is increasing. This was brought out in the admirable reports of the Balfour Committee. We are getting less than we did, while America in many important markets has got ahead of us.

It has been estimated by the economic section of the League of Nations that the total world trade in 1927, when adjusted to 1913 values, was 20 per cent. greater than in 1913. I have been studying a table showing the percentage of imports into the main continental groups from leading exporting countries. Figures of this description are of course only approximate, but they are sufficiently accurate to show beyond question that we are falling behind. It is always best to know the worst so that vigorous steps may be taken to put it right.

Let us glance at the figures showing the percentage of trade derived from the leading exporting countries. These are given at the bottom of Table "A."* You will see there that in 1913 the three countries, Great Britain, Germany and U.S.A., were all about on a level, whereas by 1928 the United States had established a marked superiority.

Let us next take a few figures relating to individual countries. Please turn to Table "B," and look at Brazil, the tenth largest purchaser of our goods, if we exclude the British Empire.

In 1913 her percentage of exports from us was 24 against 16 from the United States. By 1928 the position had been reversed, and she took only 22 per cent. from us against 27 per cent. from the United States. Let us now turn to our own Dominions. In 1913 Australia's percentage of our goods was 52 against 14 from the United States. By 1928 the position here was also distinctly less favourable to us. In that year she took 43 per cent. from us against 24 per cent. from the United States. Many other countries show a like tendency.

You will have read the report of Lord d' Abernon's mission to South America. That mission did work of first rate importance. Their report tells us in language not susceptible of misunderstanding that in Argentina although enjoying a privileged position built up through years of sound and friendly economic relationship, we are not maintaining our position, while American exports have continued to increase. Again the figures substantiate these facts, as you will see if you will glance at the statistics of Table "C."

Our own returns show that the values of exports of the United Kingdom to the Argentine after reaching £31 millions in 1928, have not kept up, the figure for 1929 being something just over £29 millions.

The United States is now by far the greatest exporting country in the world, and it has been computed that the volume of her exports in 1928 was in broad figures half as much again as they were in 1922. This is an amazing development, and the facts are even more significant when it is appreciated that there has been a steady increase in the proportion of exports of finished manufactures.

I see that a report of the Federation of British Industries made reference to the rapidly expanding export trade of the United States of America. It points out that notwithstanding the potetiaities of her home market she must be driven to dispose abroad of an increased proportion of her production It is pointed out that at the present time the United States' exports are about 8 per cent. of her production and that an increase of one per cent. only in this proportion would represent an increased export figure of about £70 million. That would be equivalent to over ten per cent. of the total of British exports.

We cannot of course hope to challenge American Trade in the aggregate in view of her immense resources for the supply of raw produce and materials. But the progress now being enjoyed by that country is not confined to such commodities. Taking a few examples of manufactured goods we find that in 1928 the exports of each of the commodities named in Table "D" amounted to over 10 million dollars, and have increased since 1922 by over 100 per cent. The growth in the export of motor vehicles and motor trucks is particularly striking; motor trucks, for example, showed an increase in 1928 over 1922 of over 1,000 per cent.

Of other commodities sharing in this development some are goods "new" to this generation such as radio apparatus and calculating machines, but others represent lines in which the United Kingdom has been preeminent such as cutlery, printing machinery musical instruments, paints and varnishes. On the other hand, among the few commodities which did not share in this progress may be mentioned leather goods, cotton cloth, steel rails and textile manufactures.

May I endeavour to link up these figures with what the D'abernon Mission said in relation to Argentine trade where they deal with the demand for new commodities? They say that the large Argentine demand is for new commodities of commerce and that we do not supply them on a scale worthy of our position as an industrial and exporting nation. I prefer to leave this plain statement unadorned by further figures but there appears to be ground for the suggestion that the expenditure on new commodities has diverted money which might otherwise have gone to more staple trades.

The same general considerations might apply with equal force to other overseas markets. I must crave your indulgence whilst I give you a few details of the value of United Kingdom exports in the years 1913, 1924 and 1929, calculated at the prices ruling during 1924. I am not giving total figures of export, but only those relating to gods wholly or mainly manufactured. In 1913 the export figure on this basis woud be £788 million; in 1924—£619 million; and in 1929—£676 million. On that computation we were in 1929 over £100 million behind in 1913.

I hope it will not be thought that I am roving too far afield, but before I leave the foreign market field I should like to refer to China. China is one of the large markets of the world, and as far as our own exports are concerned is amongst the first world purchasers and took from us in 1929 over £20 millions, but this figure would have been much greater had we maintained our prewar position. The significant fact in this market is the amazing growth of Japanese and American trade, as you will see on reference to Table "E." Why those countries should increase and we decline is a matter we intend to examine.

EMPIRE TRADE.

Now a word about the Empire. During the year 1929 there were twelve countries in the world each taking over £20 millions of United Kingdom exports. Of these twelve, six were Empire countries and together they imported over £257 million of our exports as against £185 million taken by the six foreign countries.

Notwithstanding this there has been a small decline in the value of our trade with the overseas Empire during the past three years, whereas concurrently there has been a growth of our trade with foreign countries.

In 1929 the decline in our trade with the Empire, as compared with 1928, was due to the fact that India took nearly £6 million less. On the other hand, and this is a hopeful sign, we exported £1 million more to the Dominions and £1½ million more to the Colonies. The figures of our exportations during 1927 to 1929 to Canada, Australia, New Zealand, Union of South Africa and British India are given in Table "F."

Now let us look in Table "G" at the competition we had to meet in our chief Empire markets during recent years, Canadian total imports increased by over £100 millions from 1913 to 1927 but the United Kingdom secured only some £11 million of this as against £66 million secured by the United States of America. Similarly Australia increased her trade by £86 million of which the United Kingdom secured some £27 million as against £31 million by the United States of America. In India the United Kingdom and the United States each secure approximately £12 millions of the £69 millions increase. But in 1913 India took £83 million from the United Kingdom and only £3 million from the United States of America. In the case of New Zealand her imports have more than doubled and of this increase the United Kingdom supplied some £8 million and the United States £6 million. But here again it will be observed that in 1913 the United Kingdom and the United States of America figures were £13 million and £2 million respectively. In South Africa the increase of imports amounted to some £31 million; the United Kingdom securing some £9 million and the United States of America £8 million. Once again the 1913 figures give the United Kingdom as £23 million and the United States of America £3 million.

Our Empire offers us some tremendous openings, and some of the best possibilities of trade expansion in the world. We should leave no stone unturned to ascertain why our chief competitor is making such headway there and what we can do to obtain more of this great trade.

You will have noticed that I have given much space to comparison with the United States, but other countries to a lesser degree are salo giving us increasingly severe competition. Japan in certain lines, notably tex-

ties, Germany, Belgium and Italy, all contribute their increasing competition in world trade, our share in which I regret to say is declining.

Work of the Overseas Trade Department.

Now I turn to the second part of my address and it is one that I approach with more pleasure than I did that which I have just left. If I sat down without further remarks you might have said "Well, that is all very well, or very bad, but what is the Department doing about it?"

The present Goverment realise that the Overseas trade of this country cannot be improved simply by making speeches. We have, therefore, endeavoured to be constructive. I announced recently in the House of Commons that it had been decided to appoint eight new Commercial Diplomatic officers and two Trade Commissioners for overseas service.

That is, I am convinced, a step in the right direction, for it is not one of our chief duties to be yonr overseas intelligence service? We are also strengthening our staff at Headquarters.

I believe you think well of the work of the Department of Overseas Trade, indeed your support has on occasion turned the scale when certain false economies threatened to cut down this essential service which had been devised especially for your use. I am sure that you will accordingly welcome any step that is taken to improve its usefulness.

Overseas Trade Development Council.

You may have seen in this morning's press the announcement about the Overseas Trade Development Council.

Although the Council had begun its work I delayed making anything public about it until to-day because I thought that the most appropriate occasion for explaining why it has been set up, and what it is to do, was at this luncheon where I should be amongst those who are so closely associated with my Deparment's work.

When I came to the Department I found it doing splendid work in supplying business men with information on a great variety of subjects connected with our export trade, and also carrying on overseas trade enquires. But its higher staff were so overworked on routine matters that I was without what I might term a general staff able to devote the time necessary to study adequately problems of export trade. The simple fact was that the Department was overworked and understaffed. It was the result of an increased use of its services and of imprudent economies in the past

I felt that this must be put right.

I wanted, working with me, day in and day out, a small and special staff who would help me in investigating the export trade position, as a whole, as well as by markets and by trades.

Accordingly I asked Lord Derby, the President of the Travel Association of Great Britain and Ireland, to release Mr. Beale from his duties as General Manager and allow him to return to Headquarters. Mr. Beale is well known to many of you. He is now a member of the Council, and his duty will be to study with the other members, the export trade position and carry out abroad, in collaboration with our overseas officers on the spot, any special investigations that the Council may consider necessary. He is well fitted to that task for he is an expert in market investigation, having been for many years one of His Majesty's Trade Commissioners.

As Mr. Beale must be abroad most of the year I felt that the Council must have another officer to be usually at headquarters, and, in addition to being a member of the Council to act as its Secretary. He is to be a liason officer between the Council and those home industries which we shall be considering. I therefore, recalled Mr. Mullins from the Export Credits Guarantee Department. Mr. Mullins is well known to many of you as he has recently visited most of the big Chambers of Commerce in connection with the work of the Export Credits Guarantee Scheme. He was just the officer I wanted.

Mr. Beale and Mr. Mullins are what I might term the whole-time members of the Council. They wil do no other work.

Naturally it was essential that the Council should include Sir Edward Crowe, who, as permanent head of the Department of Overseas Trade, so ably administers the activities and ramifications of the Department at home and abroad.

To complete the official side, I enlisted the help of Mr. Lloyd, the Director of the Deparment's Trade and Economic Division, and expert economist and a gentleman always watchful to point out the misleading conclusions which are too often drawn from statistics.

But it was essential to have a few experienced business men. Sir Gilbert Vyle, much to my gratification agreed to serve and I was fortunate in enlisting the help of Mr. Matters, M.P., who has had a long and close association with South American trade, *Mr. Hugh Lewis, a name prominent in the* [illegible] ose

practical knowledge of home and foreign financial problems will be most valuable.

These gentlemen complete the Council proper. But it seemed to me that I ought also to have for consultation with the Council some other leading business men who would advise it on special points that might come up for consideration. I accordingly formed a panel of a few gentlemen who have consented to come and help us when, from I am very much indebted to them for their wilingness to help. Their names are well known to you and are:—

Sir Arthur Balfour,
Lord Barnby,
Sir Ernest Jardine,
Sir William Larke,
Mr. Kenneth Lee,
Sir William Clare Lees,
Mr. J. G. Nicholson,
Mr. P. J. Pybus, M.P.
Mr. G. E. Rowland,
Dr. E. C. Snow,
Major Frank Wedgwood.

It is our intention to add other names to this panel as time goes on. We shall hope also, to keep in cose touch with your Chambers of Commerce as well as with other industrial organisations both for consultation and advice as well as to prevent overlapping.

The Council will examine large problems of export trade: study present and potential markets, constantly review the volume and trend of trade, investigate the reasons for decline in exports as a whole and by trades and markets, and ascertain possible remedies with the object of profitable expansion of British Trade.

Already we have been at work. Lord D'Abernon and the members of his Mission met the members of the Council last week when we discussed the D'Abernon report to see how we can best act on its recommendations. We do not want the report to be pigeon-holed and for it to become sterile.

We are now considering to which overseas market we should first send Mr. Beale for an investigation. I hope to be able to make an announcement about this in the near future. Before deciding on this point the Council will naturally weigh up the relevant factors so that the utmost use can be made of Mr. Beale's expert services as a market investigator.

It is too early, with a new organisation, to indicate the exact lines upon which we shall work, experience alone will show us the best direction to follow. Conditions at home and abroad must always be big factors.

TRADE PROBLEMS.

At present times are bad in this country, but this must not let us lose the true perspective. Most of the world is productively or industrially out of balance. For instance, the key industry of Canada—wheat—produced with high wage labour, is suffering temporarily from a similar difficulty to that of rubber in Malaya and elsewhere, produced by low wage labour. Highly industrialised Germany has serious unemployment, and the same is the case of the United States.

Because our trade is world-wide, we suffer from every abnormal condition abroad, and such conditions now exist in many markets, but that is only one side of the picture. The purchasing power of many of our markets abroad depends on profitable primary production. Primary production more quickly responds to stimulation than is possible with manufacturing or secondary production.

I believe we shall see in the not too distant future prosperous markets where at present we see depressed ones. We must equip ourselves now so that our goods may sell in those markets against their rivals when the conditions improve.

If Britain is to regain world leadership in trade it will require greater effort than we have yet put forth since the war, based on more accurate knowledge and a better understanding of the position than we have had in the past. A great industrial revolution is taking place and we mnst keep abreast of the changes, both in production and distribution—indeed we should set the pace.

We have commonly thought of two partners in industry—management, or capital on the one hand, and production or labour on the other. But are there not three? Is not distribution or marketing equally important? Indeed, the three operations must be interwoven and interdependent if success is to be achieved.

I believe that by the special investigations on behalf of specific industries in particular markets, which the Development Council will undertake, we shall provide much that is constructive and helpful to those three divisions of industry and trade. The Council will endeavour to focus vital matters both in regard to goods and markets which will bring about a still closer and, I believe, a more practicable co-operation with specific trades than has yet been attempted or achieved.

* The Tables are here omitted as the purport of the text is clear enough without them.

TRADE NOTES.

SASKATCHEWAN SODIUM SULPHATE DEPOSITS—LARGE-SCALE DEVELOPMENT IN CANADA.

The Horseshoe Lake Mining Company is erecting a plant near Ormiston (about 75 miles southwest of Regina, Sask.) for the development of an important deposit of sodium sulphate. Some 200 to 250 men are at present employed on construction, and the plant is expected to cost about $500,000. Railway tracks are being laid to the deposit, which is 30 feet thick at the centre and contains at least 9,000,000 tons of the natural crystals. The sodium sulphate, which is worth from $22 to $23 per ton, will be excavated by steam shovels and dehydrated in the plant now under construction.

The company has been incorporated by the Barium Reduction Corporation of Charleston, West Virginia, U.S.A., in conjunction with the International Nickel Company of Canada, Ltd. Sodium sulphate is now largely used as a flux for the refining of nickel ores, and the Company has a ten-year contract with the International Nickel Company, under which 36,000 tons will be delivered during the first year of operation, with provision for increased quantities in later years. The plant is expected to be in operation on June 1st next. The Horseshoe Lake Mining Company also intends to supply sodium sulphate to the barium plants in West Virginia for use in the manufacture of barium sulphate, largely utilised in the rubber industry in the production of rubber tyres and other products.

The sodium sulphate will be utilised by the International Nickel Company, in conjunction with sulphuric acid produced by a new plant being constructed by Canadian Industries, Ltd., at Copper Cliff, near Sudbury, Ontario, where sulphur gases from the nickel smelter will be converted into acid and subsequently into nitre cake for fluxing copper nickel ores.

The sodium sulphate deposits of Saskatchewan have been known for many years and, as a result of examinations conducted by the Dominion Department of Mines, it has been established that they contain well over 100,000,000 tons of the natural hydrous salt. These deposits have been looked on as of great potential value not only to meet commercial markets in Canada but because of the possibility of developing important export markets. One of the important uses in Canada is in the pulp and paper industry where large tonnages of the anhydrous sodium sulphate or "salt cake" are used in the production of sulphate or kraft pulp.

Imports of salt cake into Canada in 1929 were recently given by the Dominion Bureau of Statistics as 39,512 tons valued at $514,212; in addition to which Glauber's salt to a total of 362 tons at $4,450 and bisulphate of soda or nitre cake amounting to 80,872 tons valued at $1,081,984 were also imported.

Against these requirements for sodium sulphate or its products, the production of natural sodium sulphate from Canadian deposits during 1929 totalled only 6,592 tons valued at $70,396. The new industry starting at Ormiston, Saskatchewan, may therefore be looked upon as the beginning of utilisation on a large scale of the hitherto almost unexploited deposits of this valuable chemical which is found in such abundance on the prairies of Western Canada.

RAYON AS A PAPER-MAKING MATERIAL.

In the *Bureau of Standards Journal of Research* (1930, 4, 203-211) M. B. Shaw and G. W. Bicking give an investigation of the presence of rayon in rag stock in paper making, the following being their abstract of the paper:—

Laboratory tests were conducted at the Bureau to determine the paper-making quality of rayon when treated the same as rags are in the production of fine papers. Cotton and linen fibres are commonly used for papers such as bonds and ledgers, on account of their strength and durability. In addition to their value in these respects, they are used in the manufacture of papeteries and other fine writing papers also to impart softness and other desirable characteristics of surface and finish. The presence in rag stock of any fibre which would adversely affect these qualities of the paper is undesirable. Since increasing amounts of rayon are being found in rags and textile waste used in rag-paper manufacture, the test data are believed to be of value to that industry.

Samples representative of the four general processes of rayon manufacture—viscose, nitrocellulose, cuprammonium, and cellulose acetate—were included in the tests. The equipment employed in the preparation of the pulp and its subsequent conversion into paper was on a laboratory scale, and is that used at the bureau for the preliminary tests of all paper-making materials under investigation. The caustic soda and lime process

were each used in the cooking operation. Paper-making stock was prepared from the pulp, alone and in admixture with sulphite pulp, and converted into paper on a sheet mold.

Owing to loss of strength when wetted the rayon filaments tended to break into short lengths during the preparation of the paper making stock without the fibrillation and fraying necessary for good felting properties. As a consequence the all-rayon sheets lacked the strength to withstand the handling necessary in the pressing and drying operations and the pliability characteristic of rag papers. Likewise, sheets made of rayon admixture with sulphite pulp were considerably weaker than those made from sulphite alone.

The test data indicate that rayon is valueless in the rag stock for high-grade papers and may actually be detrimental to their quality.

The above journal containing this paper may be purchased by remitting the price, 40 cents, to the Superintendent of Documents, Washington, D.C., U.S.A.

SUBMERGED COMBUSTION.

There is now being carried out with great success in the chemical industries the concentration of such extremely difficult products as phosphoric acid and sulphuric acid, using submerged combustion, and in this connection a highly interesting paper has been read by C. Featherstone Hammond before the Institute of Fuel (London).

The essential requirement for a flame to burn continuously beneath the surface of water or other liquid, using either gaseous, liquid, or pulverised solid fuel at the burner, necessitates an enormous rate of heat emission so as to prevent the flame from being cooled and extinguished; but other factors are also of imporance, particularly proper mixing of the fuel and the air and the elimination of the danger of the flame striking back.

The "Hammond" burner is claimed, after a number of years' detailed research work, to have solved these problems, and the complete equipment as supplied by Submerged Combustion, Ltd., of London, is certainly of the most ingenious character. When using gas, for example, the exact theoretical amounts of air and gas for complete combustion are supplied to the burner under pressure. London town's gas of 500 B.Th.U per cubic foot requiring 4.7 volumes of air and 1.0 volumes of gas, each at 5.0 lb. pressure. This is obtained by the use of a small electric-driven duplex booster in the circuit, which delivers the gas and the air separately to a proportioning valve capable of very accurate adjustment by means of which the correct volumes of air and gas are passed to the burner. This has in the head a mixing device consisting of four vertical tubes with axial slits for the gas. Both sets of slits discharge at different angles to a central wide-diameter tube or chamber, and the result is a violent turbulent mixing action of such an effective character that compustion is completed low down in the burner, the theoretical amount of air being supplied.

The burner is fixed below the surface of the water or other liquid and constructed of steel, gunmetal, or any desired non-corrodible alloy, and it is lined with the refractory material Alundel. The rate of combustion is so enormous that about 20,000,000 B.Th.U. are given out per hour for every cubic foot of combustion space. The flame burns quite easily under water, aqueous solutions, molten metals, and other liquids; and very valuable for the chemical industries is the earthenware pots or containers which are used with the greatest ease in a manner impossible with external heating.

Naturally the efficiency of the heat transmission is very high, about 95 per cent., and from the scientific point of view it is interesting that a submerged burner of this kind in evaporating a liquid gives the same results as that of partial vacuum, due to Dalton's Law of Partial Pressure. Some of the other applications are drying, melting metals, polymerising linseed oil, and heating buildings.

THE PRODUCTION OF PLATINUM IN CANADA.

Most of Canada's platinum is recovered in the treatment of the nickel-coppered ores of the Sudbury district and the increased production of these ores consequent upon the present extensive development programme being carried out in that area, indicates that Canada's output of platinum metals is likely to grow. Prices of platinum in 1929 showed a downward tendency, the closing price in New York being around $61 per ounce as against the opening price of $70 per ounce at the beginning of the year.

NOTICES OF BOOKS, ETC.

We have received the comprehensive *Price List of Fine Chemicals* manufactured by Messrs. Harrington Bros., Oliver's Yard, 53, City Road, E.C.1.

The chemicals listed include a wide range of organic compounds, metals, metallic salts minerals, reagents and solutions. Attention may be drawn to the firm's speciality, magnesia (magnesium oxide) both levigated and ponderous.

Analytische Chemie, By Prof. F. P. TREADWELL and Prof. W. D. TREADWELL. Volume I. *Qualitative Analyse*. Fourteenth Edition. Pp xvi+578. Leipzig and Vienna. Franz Deuticke. 1930. Price 15 marks.

The late Professor F. P. Treadwell's *Kurzes Lehbuch der analytische der Chemie* has such a world wide reputation that it needs no introduction to readers of *The Chemical News*. It may come as a surprise to many that the original German work has now reached its fourteenth edition, having been revised by Professor Treadwell's son and successor as Professor of Analytical Chemistry at Zurich.

All the excellent features of the earlier editions have been retained whilst new matter has been incorporated and certain revisions made. Among the additions to the new issue of Volume I are new chapters on the Ionic Theory, the rare earths and the platinum group of metals. Revisions and insertions of new paragraphs appear in connection with the acids of phosphorus and silicon, fields in which new methods are available.

The new edition, which definitely brings this standard work up to date, will continue to serve the present generation of students as have its predecessors for three decades.

Rasa-Jala-Nidhi or Ocean of Indian Chemistry, Medicine and Alchemy. By Dr. BHUDEB MOOKERJEE, M.A. Vol. III. Pp. xviii+390+8. Calcutta: The Author, 41a, Grey Street. London: Luzac & Co., 46, Great Russell Street, W.C. 1930. Price six rupees.

Dr. Bhudeb Mookerjee is to be congratulated upon his endeavour to compile a systematic and comprehensive treatise on Hindu chemistry, medicine and particularly alchemy. The third volume of his *Rasa, Jala-Nidhi* has now appeared and is concerned with the extraction and treatment of iron, zinc, tin, lead, mixed metals, e.g., brass, precious stones, alkalis, salts and poisons.

In unison with the previous volumes, the Sanskrit text is accompanied by an English translation and it is evident that Dr. Mookerjee has spent much time and thought in collecting and arranging the material for his volumes, although he does not quote the sources from which it has been drawn.

In the particularly interesting chapter on alkalis (ksharas) the author states that three are distinguished and correspond with potassium carbonate, natron and borax, whilst nitre and sal ammoniac are sometimes included with them. It is clear that the ancient Indians were familiar with potashes and other crude chemicals but some of the methods of treatment, as for instance in the purification of the metals, will seem fantastic to modern chemists. Nevertheless much of the present volume is of considerable interest and its value is increased by Dr. Mookerjee's occasional explanatory footnotes. Thus, his remarks on nitre illustrate this very clearly. The colloquial Indian name for this chemical is *sora* or *soraka* which, he urges, is a corrupted form of the sanskrit usara and usaraka. Others have declared that nitre was unknown to the ancient Hindus bnt Dr. Mookerjee points out that it was known to them at the time of the composition of the oldest portions of the Vedas.

The three volumes of the *Ocean of Indian Alchemy* which have so far appeared are useful contributions to a knowledge of early Indian chemistry and future volumes will be awaited with interest.—*J. G. F. Druce.*

Latex. By ERNEST HAUSER (with Patent Review by C. B. VON BORNEGGI. Translated by W. J. Kelly. Pp. 201. New York: Chemical Catalogue Co. 1930. Price 4 dollars.

Although crude rubber and its application have heen the subject of many systematic investigations there has been relatively little attention paid to the properties of the latex. At least, a beginning is now being made, through the attention focussed on the possibility of the industrial application of other types of latex besides those obtained from *Hevea braziliensis* and other "rubber" trees. Isolated observations upon the various properties and characteristics of latex

from different sources and of its coagulation and general behaviour have been recorded in many journals and the author has now collected these and systematically correlated the information in the form of a useful monograph which should meet a pressing need when attention is at last being claimed by the raw products from which rubber goods are derived.

The species yielding rubber, gutta percha and balata are described together with an account of the modes for collecting the latex. A chapter is devoted to the physical and chemical nature of the latex, others to its coagulation, preparation, preservation, industrial applications, etc. The book goes really farther than its title would suggest, especially in regard to accounts of the technical applications and the internal structure of rubber although these are natural corollaries of the subject.

The American edition should prove as popular as the original German one which appeared about two years ago.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery

Latest Patent Applications.

10,561.—Thomas, J. and Imperial Chemical Industries, Ltd.—Production and use of azo dyes. April 3.

10,761.—(I. G. Farbenindustrie Akt.-Gss. —Production of acetals. April 4.

10,765.—(I. G. Farbenindustrie Akt.-Gss. —Production of alkyl-arakyl &c. esters. April 4.

10,886.—(I. G. Farbenindustrie Akt.-Gss. —Esterification of fatty acids. &c. April 5.

10,361.—(I. G. Farbenindustrie Akt.-Gss. Manufacture of nitrogen-containing derivatives of benzanthrone series. April 1.

Specifications Published.

327,141.—(I. G. Farbenindustrie Akt.-Gss. Manufacture and production of vat dyestuffs containing nitrogen.

327,175.—(I. G. Farbenindustrie Akt.-Gss. —Manufacture and production of halogenated [illegible] Naphtha

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By J. G. F. Druce.

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TIME.

I never knew the old gentleman with the scythe and hour-glass bring anything but grey hairs, thin cheeks, and loss of teeth.
—Dryden.

LONDONERS were startled by the appearance of a bulletin thus :—

Daily Telegraph

NEW THEORY OF TIME

SATURDAY, APRIL 19

It appears that Professor Gilbert N. Lewis, of octet-theory fame, has advanced a new view of time that appeals to the public fancy. *The Daily Telegraph* quotes the following words from Dr. Lewis :—"The universe may return at some time to exactly its present condition in the same way that a pack of cards, if shuffled indefinitely, will return to the original state."

It should be mentioned that this statement seems to have been interpreted : *that fundamentally time moves both ways*, and it was made on the occasion of a dinner given in New York when Professor Lewis received the gold medal of the Society of Arts and Sciences.

It is not our purpose to criticise such a remarkable statement here, but those interested in such matters will, if on the lookout, doubtless hear more about it.

FURTHER OBSERVATIONS ON THE PHYSICAL CONSTANTS.

(*Concluded from page 262.*)

There are two pages in Birge's long paper that are of particular interest in connection with the precision evaluation of the physical constants—or at least in the attempt to refine the values to a comparatively high degree of accuracy. These pages (46-48) will be quoted here :— From Bohr's theory we have $R_H = R_\infty/(1+m/m_H)$, and $R_{He} = R_\infty/(1+m/m_{He})$, where R_∞ = Rydberg constant corresponding to a nucleus of infinite mass, m = mass of the electron, m_H = mass of the nucleus of the hydrogen atom, and m_{He} = mass of the nucleus of the helium atom. For convenience m, m_H, and m_{He} are here measured in atomic-weight units. From the above equations we obtain

$$m/m_H = (R_{He} - R_H)(m_{He} + m)/R_H(m_{He} - m_H).$$

Houston (*Phys. Rev.*, 1927, *30*, 608; [see also *Chemical News*, 1928, *136*, 161-165, where an account of Houston's classical paper is given]) writes and uses $(m_{He}+m)$ incorrectly as $(m_{He}-m)$. In order to use directly the atomic weights, H and He, we write $m_H = H - m$, $m_{He} = He - 2m$, thus obtaining $m = (R_{He} - R_H)(He - m)(H - m)/R_H(He - H - m)$.

The valne of m, as used on the right side of the equation, need not be known with great accuracy. [0.0005454 can be used, and it will give practically the same left-hand value of m as a higher value 0.000548]. The equation then gives an accurate value of m [the left-hand value obviously], where now m *must* be expressed numerically as the *atomic weight* of an electron, as implied in the statement above.

From the definition of the Faraday [see *Chemical News*, 1930, April 25, where the value of the Faraday is discussed] we have (in this equation $e/m = F/m$, the two m's are not numerically the same. e/m is merely a ratio, but if e = electronic charge, m = electronic mass in grams. In F/m, m is necessarily the atomic weight of an electron as used in the above long equation) :—

$$e/m = F/m = FR_H(He - H - m)/(R_{He} - R_H)(He - m)(H - m).$$

Houston's new experimental results are

$$R_{He} = 109722.403 \pm 0.004 \text{cm}^{-1},$$
$$R_H = 109677.759 \pm 0.008 \text{cm}^{-1},$$

The stated errors are purely least squares probable errors. Houston remarks that he believes the *relative* values of R_{He} and R_H are correct to 0.02, although the *absolute* error in each may be about 0.05 (the absolute values of R_H and R_{He}, depend on the absolute wave-lengths of the various spectral lines involved. These in turn depend on the wave-length of the red Cd line measured in cm. The wave-length of this line at 15°C. A_n, is 6438.4696 I.A., *defining* the International Angström unit (I.A.). An I.A. unit is intended to be 10^{-8}cm, and the probable error is of the order of one part in several million), and this seems to the writer [Birge] as a reasonable estimate of error.

The actual value of R_H is obtained from the strong member of the long wave-length component of $H\alpha$, assuming in accordance with the new wave-mechanics that this component consists of one strong and two weak members (see Houston's paper : also part of same in *Chemical News* cited above). Houston's microphotometric curve of the long wave-length component shows no asymmetry. The calculated correction to be made to the observed centre of gravity in order to obtain the strong member is only 0.00056cm^{-1}. This amounts to 0.04cm^{-1} in R_H. In a similar way the correction in the case of $H\beta$ corresponds to 0.013cm^{-1} in R_H. For R_{He} there is no such correction, since the desired lines are measured directly. Houston's values of R_H, resulting from $H\alpha$ and $H\beta$, differ by only 0.021cm^{-1}. This tends to confirm the applied corrections, and it seems to the writer [Birge] that these corrections must be essentially right, and that the resulting $(R_{He} - R_H)$ can scarcely contain unknown errors of more than 0.01 or 0.02cm^{-1}. I therefore assume

$$R_{He} - R_H = 44.644 \pm 0.020,$$

where the second doubtful figure is carried mainly in order to get a more exact comparison of the various possible results.

Houston used $m = 5.4 \times 10^{-4}$, $He = 4.0001$, $H = 1.0077$, $F = 96470$ abs. coulombs, and obtained $e/m = (1.7606 \pm 0.0010) \times 10^7$ E.M. UNITS. Using his constants and the correct formnla—4th long one above—the result is 1.7603. The error in his formula is therefore almost negligible. The values of the necessary auxiliary constants adopted in this paper are

$$H = 1.00777 \pm 0.00002.$$
$$He = 4.0022 \pm 0.0004.$$
$$F = 96489 \pm 7 \text{ abs. coul. or}$$
$$F = 9648.9 \pm 0.7 \text{ abs. E.M. UNITS.}$$

m is given by the equation above as

$$m = F/(e/m) = 9648.9/1.761 \times 10^7 = 5.48 \times 10^{-4}.$$

The entire probable error in e/m, due to errors in all factors of the long equation above (3rd), aside from $(R_{He} - R_H)$, is less than 0.01 per cent., and so is entirely negligible compared to the error in $(R_{He} - R_H)$. It may be noted that in the 3rd long equation above He enters in such a manner that the combined proportional error in $(He - H - m)/(He - m)$ is only one-third the proportional error in He itself.

Using Houston's value of R_H, and of $R_{He} - R_H$ (equation above giving 44.644), together with the values of H, He, etc., just quoted, we obtain from the 3rd long equation $e/m = 1.7608 \pm 0.0008 \times 10^7$ abs. E.M. UNITS. This value of e/m thus agrees with that obtained by Babcock. Summarising the results we find—

$e/m = 1.769 \pm 0.002$ from deflection experiments,
$= 1.761 \pm 0.002$ from Zeeman effect,
$= 1.761 \pm 0.001$ from H and He spectra.

The discrepancy between the first result and the last two is four times the probable error of the first, and according to the Gaussian error curve, there is only one chance in 143 of this occurring. Hence the discrepancy seems to be real.

Now the last two results constitute measurements of e/m for electrons *inside of an atom*, based upon the quantum theory of atomic structure. The first result is the measurement of e/m for electrons *in free space*. The figures thus point to the startling conclusion that the e/m of an electron is less when *inside* an atom than when it is *outside*. If this conclusion seems unacceptable, then it would appear that there is some general error in the equations of the quantum theory of atomic structure. The final alternative is that there is some unknown general error in all the deflection experiments. No matter what may be the cause of the discrepancy, the very fact of its existence appears to the writer [Birge] to be of profound significance. Under the circumstances, it seems to be necessary to assume two different values of e/m, one to be used in all cases involving atomic structure, and the other involving free electrons. These may be called the *spectroscopic* and the *deflection* values of e/m — Quotation ends here. The present writer has made a few trivial changes to facilitate type setting, etc.

The above discrepancy was discussed by the present writer in this Journal (see above

The e/m values may be tabulated thus :

Houston's value ...	17608000.
Babcock's value ...	17606000.
Wolf's (cor. value) ...	17689000.
Writer's "π value" ...	17665515.
Writer's "137 value"	17692766.
Kirchner's value ...	17703000.
Average value ...	1.766×10^7

Birge's value for m, in atomic weight units, is 0.000547922, this being the *spectroscopic* value. His value for *deflection* is 0.000545444, also in the same units.

If now Birge's value 0.000547922 be introduced into the right-hand side of the 2nd long equation above, giving the value of m on the left, and Houston's R_H and R_{He} values above are used together with Birge's atomic weights for $H = 1.00777$ and $He = 4.0022$, then m comes out at 0.000547992.

If now the same calculation be made with $m = 0.00054542$, the final value of m comes out at 0.00054799, which shows that the value of m as used in the right-hand part of the equation makes very little difference in the value of m computed in this way, as Birge has stated. If the part of the equation : $(He - m)$, is changed to $(He - 2m)$ still the result is practically the same.

There is another important calculation that has already been referred to in these columns, and that is the one arising out of Bearden's new wave-lengths (see Loring, *Chemical News*, 1930, *140*, 210-212) as discussed by A .H. Compton (*Journ. of Frankl. Inst.*, 1929, *208*, 605-616). The results have already been cited on page 211 of this Journal, so it will only be necessary to give the usual calculation here.

Using Bearden's wave-length for the copper $K\beta$ line, the grating space, D, of a calcite crystal can be calculated from the equation,

$$n\lambda = 2D\sin\theta\{1 - (1 - \mu/\sin^2\theta)\}$$

where μ is the index of refraction, n is the integer giving the order of the spectrum, D is the distance between the successive layers of atoms, and θ is the glancing angle of diffraction. Siegbahn and Dolejsek (*Zeit. f. Phys.*, 1922, *10*, 160) find that the value of θ in this case is 12° 15′ 28.2″ for $n = 1$, with the calcite crystal at a temperature of 18°C. Therefore $\sin\theta = 0.229334$.

Compton gives for the value $(1 - \mu)/\sin^2\theta$ for calcite 1.46×10^{-4}. See his book X-RAYS AND ELECTRONS (1926) p. 212. These data give for the grating space of the calcite (100)

D calcite $=3.0366 \pm 0.0004$A at 18° C.
and D calcite $=3.0367 \pm 0.0004$A at 20° C.

Now the grating constant of a crystal the structure of which is known can be calculated in terms of Avogadro's number, as in the case of a simple cubic crystal

$$D = (W / N\text{D})^{1/3}$$

where W is the molecular weight of the substance, N is the number of atoms per gram atom (Avogadro's number) and D is the crystal density. For other than simple cubic crystals, the right-hand side of this equation has to be multiplied by a simple numerical factor. The molecular weight is believed to be known with high precision.

From a relation similar to that just given Avogadro's number may be determined thus:—

$$N = (nM / \text{D}\phi)(1 / D^3)$$

where for calcite,

$n =$ one half.

$\text{D} = 2.7102 \pm 0.0004$g. cm^{-3}*.

$M = 100.078 \pm 0.006$†.

$\phi = 1.09630 \pm 0.00007$‡.

$D = (3.0367 \pm 0.0004) \times 10^{-8}$cm.

Then,

$$N = (6.0142 \pm 0.0026) \times 10^{23}.$$

Knowing Avogadro's number, the electronic charge e is given in terms of Faraday's constant of electrolysis, F, by the relation,

$$e = F / N.$$

Using the values§ $F = 9648.9 \pm 0.7$ E.M. UNITS and $c = 2.99796 \times 10^{10}$cm./sec., e becomes $(4.810 \pm 0.002) \times 10^{-10}$ E.S. UNITS.

A method of obtaining Planck's constant h on the basis of this work is through the measurement of the limit of the X-ray spectrum by Duane and his collaborators. Writing the Duane-Hunt law in the form $h = Ve\lambda / c$, where V is the potential applied to the X-ray tube, λ is the minimum wavelength, and expressing λ by the first equation above (of this section of the article), remembering that in this case $n = 1$,

$$h = (2 / c)Ve \sin\theta(1 - b),$$

where $b = (1 - \mu) / \sin^2\theta = 1.46 \times 10^{-4}$.

The experiments of Duane, Palmer and Chi-Sun-Yeh (*Journ. Opt. Soc. Am.*, 1921, *5*, 376) give directly the value of $V \sin\theta$ as 2039.9 ± 9 volts. Using the values e and D obtained above

$$h = (6.629 \pm 0.004) \times 10^{-27} \text{ erg. sec.}$$

If Bohr's expression for the Rydberg constant, R_∞ multiplied by c, be taken then

$$R_\infty c = 2\pi^2(e^5 m / h^3 e).$$

Solving for the value of e/m, from this equation $[e/m = 2\pi^2 e^5 / h^3 c^2 R_\infty]$, when $R_\infty c = 3.289884 \times 10^{15}$, then

$$e/m = (1.769 \pm 0.003) \times 10^7 \text{ E.M.U.G.}$$

Birge gives $m = (9.03510 \pm 0.010) \times 10^{-28}$ gram, this being the so-called spectroscopic value. While this m enters into the Bohr equation above, the following derived equation can be obviously solved for e/m without working with this m value.

Compton's results have already appeared in these columns—see page 211 of this volume (140).

The present writer has taken the essential parts of the above almost bodily from Compton's paper, but it should be read in *conjunction with the other articles in this* Journal, particularly those which appeared during the month of April, 1930, pages 210, 242, 244 (validity of Einstein's equation for the red-sensitive sodium compounds), and page 261.

Attention should be drawn to the desirability of carrying out the calculations a little beyond the significant-figure range. An example will illustrate this better than words can explain.

If the value $R_\infty c$ be taken as 3.28988×10^{15} then dividing c into it should of course give R_∞, but not accurately because there should be another figure in the decimal shown above. The actual value of R_∞ obtained by neglecting this matter is 109737.288, which is *too low* if Houston's value be adopted as Birge has done. In short, it is best to *assume* that the individual values or constants adopted are absolute, and then to carry out the calculations well into the decimal region, or to equivalent figures, especially when *comparisons* are being made in the discussion as to the most likely values.

To avoid deception, however, it is well to indicate what is being done in this respect.

F. H. LORING.

* See O. K. De Foe and A. H. Compton, *Phys. Rev.*, 1925, *25*, 618.

† See R. T. Birge, *Phys. Rev. Sup.*, 1929, *1*, 1.

‡ See H. N. Beets, *Phys. Rev.*, 1925, *25*, 621.

§ See J. Thibaud, *Comptes Rendus*, 1926, *182*, 55; or *Rev. d Opt.*, 1926, *5*, 97.

ON THE ORIGINS OF SUN-SPOTS AND ERUPTIVE PROMINENCES.

A Mr. Angus P. Stevens of Quebec, Canada, in a letter to the Editor of *The Chemical News*, proposes in outline a theory of the sun-spots and prominences of which the following are the essential features suggested.

After the outer layer of the sun has given off by radiation heat for a time the sun becomes appreciably cooled and conse-

quently contracts. This contraction increases the pressure within the body of the sun thereby causing jets to issue which are the eruptive prominences. These jets issue through "weak spots" which are caused by the sun's rotation. The upper portions of the highest of these jets, or prominences, suffer a cooling action in their upward and downward journeys, and they become more dense in consequence and darker in colour especially when they fall back upon the body of the sun. The material of these jets therefore sinks to the photosphere and appears as dark patches which are the sun-spots.

Mr. Stevens further suggests that the view that the interior of the sun must be at a temperature much higher than that of its exterior is *not* supported by the low heat conducting power of the materials composing the sun "in their present states," and that the heat generation is largely a surface effect. Also it is suggested that since the photosphere must, like the matter referred to above, cool and contract through loss of heat by radiation it, too, must in a similar manner give rise to an increase of pressure within it, and so cause certain portions to rise and issue through the photosphere where there are weak spots caused probably by the sun's rotation. Dark material is thus forced up from below and as it is too heavy to issue as a series of eruptive prominences it spreads out over the outer surface of the photosphere and appears as dark patches which represent another form or feature of sun-spots.

The penumbra of any sun-spot is caused by the cool umbra conducting away from its immediate surroundings a certain amount of heat, and any vortical motion that has been observed in any of the sun-spots is due to the difference between the linear speeds of rotation of the umbra and that of its immediate surroundings and the upward and downward movement of the same umbra.

While these views of Mr. Stevens do not coincide in some essential details with those held by astronomers, we are glad to give publication to ideas that are of general interest; and no doubt the interpretation of phenomena of sun-spots and the origin of heat in the sun will in time undergo revision. Mr. Stevens does not write in the know-all spirit, but he is evidently interested in the subject as any student might be. It was Sir William Crookes' plan to open the pages of *The Chemical News* from time to time to those outside the professional world, and it is hoped that this policy can be continued.

HYDROGEN-ION MEASUREMENT.

The Cambridge Instrument Co., Ltd., of 45 Grosvenor Place, London, S.W.1., have issued a catalogue of their instruments for hydrogen-ion determination, the contents of which are as follows:—

Introduction; General Principles; Outfit A for Research Work; Outfit B for General Work; Outfit C (direct reading); Outfit D for Biological Work; Outfit E (continuous recording); The Hydrogen Electrode; The Calomel Electrode; Other electrodes, such as Clark's, Rideal's and Cole's Hydrogen electrodes; Double Quinhydrone Electrode; The Glass Electrode. Industrial and nonindustrial applications are given and finally general notes.

The introduction and general principles form a short paper in itself and owing to the excellency of its composition and accuracy it is quoted here:—

It is well known that in industrial and research processes which depend upon the interaction of liquid or semi-solid substances, there is a definite relation between the effective acidity or alkalinity of the solutions and the quality and quantity of the resultant product. The technical literature of almost every industry, and of bacteriological, biological and pathological research, contains many references to the measurement of acidity, and there is now hardly any process dealing with solutions in which such measurements are not made, either in the research laboratory or as a matter of routine. It has long been established that the actual reactive quality of a solution does not depend upon the total acidity obtained by titration, but upon the *effective* acidity, as shown by measurements of the hydrogen-ion concentration.

Of the various methods which have been used for measuring hydrogen-ion concentrations, the electrometric method is recognised as being the most accurate. It is, in fact, the only method which can be considered as standard, since it depends upon the fundamental factor of the positive electric charge carried by the hydrogen-ion. The method possesses many advantages over the colorimetric or "indicator" method, which is unsuitable for use in a number of applications and is subject to various errors, such as those due to the personal equation in the determination of end points, masked or otherwise, to unsuitable lighting or to acid, salt or protein effects. In the electrometric met

Many industrial chemists have hesitated to adopt the electrometric method of analysis owing to a mistaken impression that it is too difficult and complicated for a works laboratory. With the apparatus described in the following pages, however, the accurate determination of hydrogen-ion concentrations becomes a comparatively simple matter; the technique even of the more elaborate laboratory outfits can be readily mastered, while the simpler outfits designed for general industrial purposes can be used by non-technical men for routine measurements after a little training.

From the apparatus described, customers will find it possible to select outfits suitable for practically every industrial or scientific application, from research investigations requiring the highest possible degree of accuracy to routine industrial measurements where a simplified procedure is desirable. The apparatus has proved valuable in such applications as the determination of the hydrogen-ion concentration in blood, or in various media including coloured solutions such as wines, dye baths, tanning liquors; in opaque solutions and those containing emulsions or colloidal matter such as bacteriological media, sera or fermentative vat fluids; also for the standardisation of indicators and the investigation of the action of neutral and buffer salts and the electrometric titration of acids and bases in these solutions. It can be used in nearly all branches of industry, including sugar factories and refineries, flour mills, bakeries, dairies, fruit and meat preserve factories, breweries, tanneries, paper mills, electroplating and electrotyping works, sanitary and water purification works, power plants, ceramic works, agricultural research works, wool, silk, artificial silk and textile dyeing factories, glue factories, chemical works, etc. Brief references to some applications are given; these are by no means exhaustive, but may serve to indicate the wide and increasing range of applications for the electrometric method of chemical analysis and control. Customers who have problems involving the reaction of solutions, or of semi-solids, are asked to forward us full particulars, when we shall be pleased to advise them as to suitable apparatus for their purpose.

Among the apparatus of particular interest may be mentioned the Glass Electrode Outfit described, which is adapted for measuring the hydrogen-ion concentration of liquids and semi-solids where only small quantities are available. This electrode has been successfully employed, for example, in measuring the *p*H values of blood (without need for carboxylation), bacteriological media, phosphate solutions, textile dyeing solutions, aqueous extracts of various substances such as bean seedlings and sycamore leaves, turbid mixtures such as flour and water, semi-solids such as the muscles of *crustacea*, and mammalian cardiac, skeletal and unstriated muscles under various conditions. Attention is also drawn to the Recording Potentiometer described, by means of which continuous records of variations in the acidity of solutions can be obtained, or the hydrogen-ion concentration automatically and continuously controlled at a desired value.

In every liquid of which water is a constituent, there is a reaction continuously in progress; a certain proportion of the molecules of which the liquid is composed dissociate into hydrogen-ions (H^+), carrying a positive electric charge, and hydroxyl-ions (OH^-), carrying a negative charge, while some of the ions simultaneously re-combine to form molecules. The state of equilibrium for any particular liquid is that in which the rate of formation of the ions from the molecules is equal to the rate of recombination of the ions, and the concentration ("concentration" of ions in a solution is the number of free gram-ions per litre of the solution) of hydrogen-ions (C_{H^+}), or of hydroxyl-ions (C_{OH^-}), under these conditions is a measure of the effective acidity, or alkalinity, of the liquid. The product of these two concentrations is constant for every liquid, from the strongest acid to the strongest alkali, thus :—

$$C_{H^+} \times C_{OH^-} = 10^{-14}.$$

The addition of acid or of alkali to a solution does not alter this constant, it only alters the proportion of C_{H^+} to C_{OH^-}. In the case of pure distilled water, which is neutral—neither acid nor alkaline—the concentration of hydrogen-ions is equal to the concentration of the hydroxyl-ions, *i.e.*, $C_{H^+} = C_{OH^-}$, and since the product is 10^{-14} $C_{H^+} = 10^{-7}$. Any increase in the acidity will increase the hydrogen-ion concentration; for example, if the acidity of a solution having a hydrogen-ion concentration of 10^{-6} is increased tenfold, the new concentration will be 10^{-5}.

When a hydrogen electrode is dipped into a solution containing hydrogen-ions, a potential difference is found to exist between the electrode and the solution, the value of which is proportional to the logarithm of the reciprocal of the hydrogen-ion concentration.

$$E \propto \log (1/C_{H^+})$$

To simplify calculations and provide a unit which can be readily understood and used, the conventional unit *p*H, suggested by Professor Sörensen, has been adopted by all investigators to represent the value log $(1/C_{H^+})$. In the case of pure distilled water for example—

$$C_{H^+} = 10^{-7} \quad \therefore \; pH = 7.$$

In order to measure the potential difference between an electrode and the solution in which it is immersed, it is necessary to utilise a second electrode or "half cell," the cell being completed by means of a liquid junction, generally a solution of potassium chloride. The concentration of the hydrogen-ions in the solution containing the hydrogen electrode can readily be determined by measuring the potential difference across the complete cell and subtracting algebraically the potential difference of the half cell. The calomel electrode is generally employed as a constant half cell. As the concentration of the hydrogen-ions in the solution lowers, that is, as the solution becomes more alkaline, the E.M.F. will rise; conversely, as a solution becomes more acid, the E.M.F. will fall.

To obtain accurate measurements of the electrode voltage, it is necessary to employ a method which does not take current from the electrodes, as the flow of current would reduce the measured voltage owing to polarisation and to fall of potential in the solution. For this reason, a potentiometer is generally employed. In order to cover the many applications of the apparatus, various types of potentiometers and electrodes are made.

This catalogue shows remarkably clear diagrams properly executed, so that the apparatus is rendered clear and according to the best draughtsmanship practice. Writers of scientific papers should study these diagrams as they show how to express with greatest clearness the features of an apparatus.

TRANS-NEPTUNIAN PLANET.

This "planet," referred to as *Lowell's Object*, according to the *I.A.U. Circ.* 271, has an orbit thus: Eccentricity, 0.909 (uncertain); semi-major axis, 217 units; mean daily motion, 1.112″; period [(360 × 60 × 60 / 1.112)/365.256], 3191 years; present distance from sun, 41.6 units. See *Nature*, April 26. If 1.112″ is 11.12″, then the period would be 319.1, agreeing with the earlier reported value (*e.g.* Jeans), but a decimal point error seems unlikely.—F.H.L.

Trade Developments and Problems

IMPORTANT FACTS REGARDING FOREIGN INTERESTS IN EGYPT.

The following is the text of Sir Henry Barker's speech as President of the British Chamber of Commerce, which speech was delivered at the General Meeting of the Chamber held on April 1st, 1930, in Alexandria:—

Gentlemen,—I do not think anyone can complain that the past year has been an uneventful one, or that the many proposals for reforms, both here and elsewhere, have not given us plenty to think about. In any case, they have kept your Committees busy, and many important questions have been dealt with since we met last year.

With the departure of Lord Lloyd, this Chamber and, in fact, the whole of our community, lost a sincere friend, a man who never missed an opportunity of trying to promote British interests and trade, who was accessible to all, who was ever willing to take an active part in promoting any undertaking which he considered might benefit his fellow-countrymen, and whose great love and devotion to his country earned the respect of all who knew him and were able to appreciate those sterling qualities which make him such an asset to the Empire.

POLITICS AND EUROPEAN COMMUNITIES.

Before saying anything else I wish to repeat what I have often said before, that politics in themselves are no concern of this Chamber, but the events of the past year have such direct bearing on the future lives of all of us, that have made Egypt our home, and are likely to have such a far-reaching effect on our trade and on our interests in general, that I feel I should not be doing my duty if I were to let this opportunity pass without making some reference to them and trying to express what I daresay you all feel about them. I do not propose to offer any opinion on the purely political aspect of the proposals made last summer for the conclusion of a treaty between England and Egypt, or on the effect that such a treaty, if concluded, will have on the general interests of the Empire.

We can sympathise with the desire to promote better feelings between the two Governments — we should even welcome a final settlement of all differences, if we did not entertain doubts about the ultimate result of the present negotiations and were

less apprehensive of our own future. We cannot be expected to look with indifference on that part of the proposals which will so materially affect our own prospects as the abolition of the Capitulations and of the guarantees we now enjoy for the safety of life and property in this country.

In the few remarks I have to make on the subject, I hope I shall not be accused of any lack of sympathy with the wish of our Egyptian friends to further the general interests of their country and to develop its resources more fully, or of any wish to oppose useful reforms. I am as much concerned as anyone to see the land I live in prosper, and I am sure I will be pardoned if, at this very critical moment, I ask that the fullest possible guarantees should be forthcoming for the Europeau Communities in Egypt.

If the privileges we enjoy under the existing regime have proved to our benefit, it cannot be denied that they have conferred corresponding advantages on Egypt itself. It was under the ægis of the Capitulatory regime that foreigners were first able to settle in this country, and the leading part they have played in the last 100 years in the development of its trade and industry is too important to be overlooked, and their interests are now too large to be ignored. Their welfare to-day is so bound up in that of the rest of the people that any failure to assure the one is bound to reflect unfavourably on the other.

Foreign Capital in Egypt.

It is difficult to estimate with any accuracy the amount of foreign capital invested in Egypt. That it is considerable is obvious, and it is easy to show that the share in Egypt's wealth held by Europeans is out of all proportion to their numbers. The market value on the 31st December last of public loans, stocks and shares quoted on this Stock Exchange totalled nearly L.E. 200,000,000. It is no exaggeration to say that 90 per cent. of this amount is held by foreigners in and out of Egypt, in addition to which it is not unreasonable to suppose that an equally large amount is invested by them in their private businesses, in companies the shares of which are not quoted locally, in land and in house property in the large towns. On the other hand, we know that the area of agricultural land owned by Egyptians is just under five million feddans, the value of which cannot exceed L.E. 600 million. [" L.E." is £ Egyptian.]

My figures may not be quite correct, but they are near enough to being so to demonstrate what the minorities in the country represent, and how important it will be to guarantee fully their interests and to see that any trade facilities which may be granted to some should be equally given to all.

No man can seriously contend that he has a right to live in any country and not subscribe his fair share to its upkeep, but every taxpayer has a right to be satisfied that there is a good case for increased taxation, which in the present state of Egypt's finances may be difficult to prove, and such taxation will be reasonably imposed, impartially levied, and judicially spent.

The belief which appears to prevail in some quarters that the whole burden of taxation in this country is borne by the Egyptian, and that the foreigner pays nothing, is an instance of how almost any statement, if repeated often enough, becomes accepted as the truth. With the exception of the Ghaffir case, and this discrepancy will very shortly disappear, I know of no tax, direct or indirect, which is not paid by foreigner and Egyptian alike. The fact is that the bulk of the Government's revenue is derived from indirect taxation, from which none escape, and if the whole truth were known I daresay it could be shown that in proportion to their numbers the foreign communities contribute the largest share of these receipts.

It is, of course, true that the incidence of the land tax, which although the chief item of direct taxation, is only about 14 per cent. of the State's total revenue, falls more heavily on the native than on the foreigner, for the simple reason that most of the land is held by Egyptians. Where, however, foreigners do own land, they pay their rates and taxes in full, and according to the latest statistics nearly 10 per cent. of the whole of Egypt's cultivated area is in the hands of non-Egyptians. In this connection it must be remembered that the whole of the Government's expenditure on irrigation and agriculture is for the direct benefit of landowners. It might be claimed that the land tax is no tax at all, but a water rate. The fact that certain lands are exempted in years of low flood goes far to support such a claim.

Furthermore, the foreign communities derive no benefit whatever from such items of expenditure as educational services, missions and hospitals, which occupy such a prominent position on the debit side of the

Budget. It is interesting to note that in the year 1927-1928, whereas direct taxation worked out to only about 460 milliemes, or 9s. 5d. per inhabitant, the contribution per head by way of indirect taxation was 823 milliemes, or 16s. 11d.

CAPITULATIONS.

The proposal to transfer Criminal Jurisdiction from the various existing Consular Courts to the Mixed Tribunals, important as it is, is not one to which in principle any very serious objection can be raised. The utmost care must, however, be taken in compiling a code, adopting a procedure, and appointing a sufficiently experienced personnel to insure a prompt and impartial administration of justice. As in the considered opinion of your Committees the measure of protection to meet the needs of our community suggested in the White Paper was not only inadequate, but in no way commensurate with its position and the large interests it has at stake, serious representations were made in the proper quarter, and I am glad to tell you that the Chamber was asked to submit its views on the whole question to H.E. the High Commissioner for transmission to H.B.M.'s Government. We have therefore sent in a note, dealing as fully as possible with the whole subject, and enumerating what we feel to be the minima of safeguards which should be insisted upon. I trust it will receive the consideration it deserves.

We do not ask for any preferential treatment, but it must be remembered that the European Communities, with their vast interests, have very definite and well-established rights, and no Government can be justified in surrendering them voluntarily or in whittling them away. We do ask, however, that those rights should be safeguarded, and that the trading facilities we now enjoy should in no way be curtailed. Unless the fullest guarantees for the safety and welfare of these Communities are forthcoming, it is difficult to look forward to the future with any degree of optimism.

NEW CUSTOMS TARIFF.

By the courtesy of the Egyptian Government, this Chamber, in common with other similar institutions, was given an opportunity of making its comments on the new Customs regime and tariff. Although the time at our disposal was short, we managed, in consultation with the Associated Chambers of Commerce of the United Kingdom, and with the Federation of British Industries, to make a fairly comprehensive report. I am glad to say that in some instances our advice has been taken, but that although we made a strong appeal for a general maintenance of the *ad valorem* system of collecting duty, the Government have, in a large number of cases, adhered to their intention to introduce a complicated scale of specific duties. There is, of course, much to be said about both systems. Specific duties are easy enough to collect on homogeneous goods, although they often militate unfairly against low priced articles in favour of dearer ones. They are, however, unnecessarily complicated in the majority of cases, and will be the cause of endless disputes between officials and traders; the delays consequent on such disputes cannot fail to prove most prejudicial to business. On the other hand, the *ad valorem* system, with all its drawbacks, is simple, and has the advantage of being thoroughly understood by all concerned.

We are, however, assured that the new duties and the new Customs law are only temporary, and if they are found to be impracticable they will be revised. Your Committees are watching the position with care and will not fail to make any recommendations which may be deemed advisable to the authorities, as time goes on. The juridical aspect of the whole question has not been lost sight of, and we are told that the necessary reserves have been made in order to protect the rights of British subjects.

Th emain object in bringing about such a drastic change in the Customs regime, were, we are told, threefold. To increase revenue, to transfer some of the burden of taxation from the masses to those better able to bear it, and to encourage local industry. All these objects are reasonable enough, but it remains to be seen whether the changes that have been introduced will have the desired effect. In any case I hold to the opinion that it would have been much less disturbing if simpler methods had been resorted to, and I cannot help feeling that a judicious revision of the old *ad valorem* tariff, would have proved more efficacious and infinitely less upsetting to the trade of the country. If more money is wanted it may just as well be collected through the Customes, as by any other channel, but it has yet to be shown how far the increased duties will impair the purchasing power of the nation. It is certainly alarming to see how much higher the duties on imported foodstuffs are to be, and disconcerting to hear amateur economists advocating a still higher level for such necessities as wheat and flour, especially when they advance the theory that the

value of wheat does not affect the price of bread.

The protection of local industries might also be effected on sounder and more businesslike lines, if instead of instituting high tariffs on imported articles, which can or might be manufactured in the country, certain essential raw materials were admitted free of all duty, where the local product is either too expensive or unsuited to the demand. The fact that the proposed new duties were made known two months before they were to come into force, was the cause of an abnormally large importation during the first six weeks of the present year of those commodities which were going to be most affected. Certain stocks are now unusually big, and it will take time to dispose of them; it will therefore be some months before it will be possible to estimate the effect of the new regime on trade in general. The Customs Administration is to be congratulated upon the way in which its officials coped with the enormous amount of extra work they had to contend with in the early part of this year.

State Finances.

If figures mean anything, State finances continue to prosper. It is true we are told to expect a heavy deficit for the coming financial year 1930-31, no less a figure than L.E. 6,888,000, is mentioned. If, however, we compare estimates for preceding years with actual results, we are not likely to be unduly alarmed by the prospect. According to the published figures the years 1926 to 1929 inclusive should have produced a total deficit of L.E. 6,717,502; the actual result for the period however was a surplus of L.E. 9,275,336. The year ending April next was expected to show a shortage of L.E. 8,460,000 but up to the 31st December last, there was an amount of L.E.3,840,000 to the good; this, however, we are assured will be considerably reduced by the end of the present financial twelve months. The general reserve fund which stood at L.E. 30,934,723 on the 30th April, 1926, had by the 30th April, 1929, increased to L.E. 39,852,369. There may be a good deal to be said for underrating receipts and over-estimating expenditure, but the practice can be overdone.

The chief reason for these startling differences is that large sums are voted annually for public works, which the departments concerned are unable, for a variety of reasons, to spend in the time at their disposal, and they therefore automatically revert to the general reserve, which we are told is all earmarked for various purposes. These purposes are however for the most part of the nature of productive capital expenditure, and might as reasonably be met by borrowing as by increased taxation. But be this as it may, until we see a marked diminution in the funds of the treasury, we can hardly be expected to accept the contention that money is wanted .

There is however a reverse side to the picture. It consists in the employment of a part of the fund, in objects which hardly seem to come within the scope of a Government, such as the purchase of cotton and advances to cultivators, industrial, commercial and co-operative societies. According to an approximate calculation a sum of not less than L.E. 6½ millions must be locked up in cotton, whilst the other objects enumerated must have absorbed L.E. 1½ million. The disregard of economic laws, which this policy implies, is disquieting for the future, for apart from the importance of the actual money involved, it is obviously easier to embark on such schemes than to draw back. Interested parties having succeeded in getting material assistance from the Government, will undoubtedly clamour for more, whenever they consider that market conditions do not suit their convenience.

During the past few years large amounts have certainly been spent in useful public works, but there still remains much more to be done and it is a matter of great concern that such an important undertaking as the extension and the improvement of Alexandria Harbour should again have been postponed, although complete plans have been drawn up under the supervision of an eminent engineer and the credits necessary to start operations budgeted for. The port of Alexandria is rapidly becoming too small for its trade, and the facilities which it offers for the handling of cargo compare unfavourably with those existing in other places. It runs a great risk of losing part of its business, if much more time is lost in starting the work, which ought already to have been well in hand.

Trade Statistics.

A glance at the trade statistics for the past year shows that Egypt had an adverse balance of some 4½ millions. Exports amounted to L.E. 51,751,394 against L.E.56,165,256 in 1928, while imports totalled L.E. 56,089,512 against L.E. 52,043,969. The fall in the value of exports can be almost entirely accounted for by the diminution in the money realised for cotton, while the increase in imports seems to be spread over the whole list, the

principal advances being L.E. 1,176,000 on cereals and flour, L.E. 546,000 on timber and coal, L.E. 690,000 on textiles, and L.E. 815,000 under the heading of Metals and Metalware. These differences may to some extent be due to importers anticipating the new duties, although the real rush to avoid them took place after the close of the year under review.

Great Britain absorbed 34.7 per cent. of Egypt's sales in 1929 against 38.3 per cent. in 1928, and on the other hand provided 21 per cent. of Egypt's purchases in 1929 against a similar percentage in 1928, while the rest of the Empire improved its position by 1 per cent. Belgium's share advanced by 1 per cent., Germany by 3 per cent., and Italy by 1 per cent.; other countries seem to have remained stationary. It may be some consolation to note that England's contribution to Egypt's Imports was no less in 1929 than in the preceding twelve months, but I think I am right in saying that it has never been smaller. The result is disappointing and I am convinced that more could be done if manufactnrers at home would study the needs of this market a little more closely. It is of course largely a question of price, but if buyers here were visited more frequently by intelligent and discerning travellers the position wonld improve. Britain has lost a lot of ground since pre-war days, and I advise any who are interested in the subject to turn up the February number of our Journal which gives full and interesting details of imports in 1928 as compared with those of 1913. The table shows that while Egypt's purchases have nearly doubled, England's contribution to them has fallen from 30 per cent. to 21 per cent.

Trade Outlook.

It is difficult to attempt to give any forecast for the future, but in spite of the fact that general market conditions in Egypt are still on a fairly sound basis, trade is exceedingly slack and the outlook is by no means encouraging. The rapid decline in the value of nearly all raw materials throughout the world, the protracted depression in most of its staple industries, the heavy fall in the price of silver, are all factors which naturally had a close influence on our market and the repercussion has manifested itself here in a sharp decline in the value of cotton, which coupled with the increase in Customs dues, must eventually curtail the purchasing power of the country.

Towards the close of the year the Government were again persuaded to try to stem the downward tendency of the cotton market with the consequence that they have had to make very large purchases and will probably have to take up a great deal more of what remains of the crop. Government interference with the natural course of any market must on general principles be deprecated. There are of course times when, if circumstances are really abnormal a little judicious assistance from the State may be welcomed, but I submit there was nothing abnormal about the market last year.

A general review of the world's trade and industry at any time in the past twelve months would have shown that a fall was inevitable, in fact it is a mystery to me that it did not come sooner. It is of course very unpleasant to see the article we all depend upon diminish in value, but it is unwise to depart from the soundest of all business axioms, that of cutting one's loss. It would have been infinitely better and more economical in the long run to have allowed the trade to dispose of the crop in the usual way, than to pile up huge stocks here which must weigh heavily on the market as long as they exist, and, unless the unexpected happens, make the sale of the new crop a still more dieffiult problem.

Share Market.

Our stock exchange has, of course, been affected by the troubles in the principal money markets of the world, and we have had to record a general shrinkage in the value of all our local securities. As far as one can judge, however, commitments here are not heavy, and Bank deposits have not appreciably decreased. One could therefore have expected that the recent reduction in the Bank rates would have had a steading effect on prices. Gilt-edged securities in other countries have certainly been in more request lately, hut here, unforturately, investors show no interest, and although there is not a great deal of selling, the little there is meets with no response from buyers. This depressing state of affairs must in the main be attributed to the uncertainty of the political situation, and to the doubts that are entertained about the future of European enterprise in Egypt.

Port Said Committee.

During the last year your Committees have done their best to enlarge the scope and influence of this Chamber, and in this respect we have received valuable assistance from our friends in Port Said, who have expressed the wish to form a local Committee in that town. I look upon the fact that they are desirous of taking an active share in the business of the Chamber

as a very happy event, and I am sure their co-operation will be most useful and prove a great asset to us all. The decision taken under my predecessor to admit as associate members non-British subjects who are interested in trade with the Empire has, I think, been successful, and we have, so far, enrolled some 97 firms, or representatives of firms carrying on business with Great Britain and the Dominions.

We have recently instituted a system of sub-committees to deal with questions relating to special sections of trade, which will enable the General Committees to get expert advice on any technical points that may arise. You will be asked to-day to agree to certain alterations in the Constitution of the Chamber to allow of the functioning of the Port Said Committee and to regulate the working of the sub-sections of Committees, which I hope will meet with your approval.

I have nothing to add to the full report Mr. Rofe, our Treasurer, has given you on the year's accounts, but you doubtless realise that they are far from being in a flourishing state, and therefore I ask you to do all you can to get us more members and more advertisements for the Journal. I think—in fact I know—that the Chamber is doing useful work, not only for trade, but for the whole of our community, and I appeal to all who think as I do, to come forward and help us. We are still, unfortunately, unable to make both ends meet, and far from cutting down expenses we ought to be in a position to increase our activities.

The thanks of the Chamber are due to Mr. Trimen and his assistants for the admirable work they have done and are doing for us. Mr. Trimen is full of energy and resource, and his long experience of Egypt is a great help to us; in fact, I do not know what I should have done without him and his advice on several occasions during the past year.

With this meeting my term of office comes to an end, and the Presidentship of the Chamber, as you know, goes to Cairo for ... years. I therefore take this opportunity ...essing to you all, Committeemen and ...s alike, my sincere thanks for the ...nd backing you have never failed ... during the time I have had the ... presiding over your destinies. [illegible] ...will be as kind and considerate to ...or as you have been to me.

Proceedings of Societies.

THE OPTICAL SOCIETY.

The Annual General Meeting of Members of the Optical Society was held at the Imperial College of Science and Technology, South Kensington, on Thursday, April 10, 1930.

Mr. J. Guild, vice-president, was in the chair.

The Accounts, Balance Sheet, and the Reports of the Council, Treasurer, and the Auditors, for the year 1929, were presented and approved and the Officers and ordinary members of the Council for the session 1930-31 were elected.

At the Ordinary Meeting which followed the following papers were presented:

Charts for Simple Two- and Three-Len Problems. By T. SMITH, M.A., of th National Physical Laboratory.

A variety of charts can be drawn, each o which furnishes complete first order inform ation on systems constructed from two o three thin lenses.

Captain T. Y. Baker and Mr. R. T Hanson took part in the discussion, and M Smith replied.

The Lustre of Textile Fibres and a Meth of Measurement. By N. O. PELTON, B.Sc of the British Cotton Industry Researc Association.

The lustre of textile fibres is due to geometrical property of transparent cyli drical filaments with polished surface Some of the factors, notably double refr tion and diffraction, which might aff lustre are discussed, and a method is su gested for measuring lustre based on t high lights visible on a curved lustrous su face.

Captain T. Y. Baker, Mr. R. T. Hans Mr. T. Smith, and Mr. J. Guild took p in the discussion, and Lr. Pelton replie

A Re-determination of the Mixture Cur of the Spectrum. By W. D. WRIG A.R.C.S., D.I.C., B.Sc.

The paper describes a method that l been developed for calculating the sensat curves and mixture curves from an aver set of trichromatic coefficients and standard luminosity curve, without recou to any further experimental data. A c plete table of colour mixture data is gi The practical value of different method colorimetry and the most desirable p aries for use as reference standards briefly discussed.

Mr. Perry, Mr. T. Smith and Mr. J. Guild took part in the discussion, and Mr. Wright replied.

Forthcoming Events, Etc.

SOCIETY OF PUBLIC ANALYSTS.

The next meeting of the Society will be held on Wednesday, May 7th, at the Chemical Society's Rooms, Burlington House, Piccadilly, W.1., at 8 p.m. The following papers will be read :—

"The Diastatic Activity of Honey." By L. H. Lampitt, D.Sc., F.I.C., E. B. Hughes, M.Sc., F.I.C., and H. S. Rooke, M.Sc., A.I.C.

"A New Metbod for the Separation of Titanium from Zirconium and Hafnium." By W. R. Schoeller, Ph.D.

"The Composition and Polymerisation of Chinese Wood (Tung) Oil." By E. R. Bolton, F.I.C., and K. A. Williams, B.Sc., A.I.C.

Informal Dinner.—Arrangements have been made for Members and their friends to dine together at St. James's Restaurant, 178, Piccadilly (opposite Burlington House), at 6.30 p.m.

UNIVERSITY OF LONDON.

PUBLIC LECTURES & SPECIAL ARRANGEMENTS.

Monday, May 5, at 5.30 p.m.—"The Conception of a Personal Universe : the Problem of Modern Philosophy." A public lecture by Professor J. Macmurray.

Wednesday, May 7, at 5.30 p.m.—"The Early History of Generation and Comparative Anatomy." First of a course of six public lectures by Professor F. G. Cole, F.R.S., *of the University of Reading. May* 7, 8, 14, 15, 21 and 22. (Lantern illustrations.) Chairman : Professor G. Elliot Smith, F.R.S.

Friday, May 9, at 5.30 p.m.—Rhodes Lectures : "The Legal and Political Duty of the Empire." First of a course of three public lectures by Professor J. H. Morgan, K.C. May 9, 16 and 23. Chairman at the first lecture : The Lord High Chancellor, the Rt. Hon. Lord Sankey, G.B.E.

ADVANCED LECTURES IN BIOCHEMISTRY.

A course of three lectures on "The Chemical Activities of Micro-organisms," will be given at the London School of Hygiene and Tropical Medicine (Keppel Street, Gower Street, W.C.1.) by Professor Dr. A. J. Kluyver (Professor of Microbiology in the Technische Hoogeschool, Delft) at 5.30 p.m. on Tuesday, Thursday and Friday, May 13th, 15th, and 16th, 1930.

SYLLABUS.

Lecture I.—General analysis of biochemical processes : dissimilation and assimilation. Oxidative dissimilation of acetic acid and other aerobic bacteria. The chemistry of alcoholic and related fermentations.

Lecture II.—The chemistry of the fermentative dissimilation of butyric acid and *butylalcohol bacteria, of the bacteria of the* colongroup, of the propionic acid bacteria and of methane bacteria.

Lecture III.—The chemistry of assimilation. General scheme for the chemical reactions to which metabolism can be brought back. Consequences of the exposed view for our insight in the mechanism of metabolic processes.

At the first lecture the chair will be taken by Professor A. Harden, D.Sc., F.R.S. (Professor of Biochemistry in the University). The lectures, which will be delivered in English and illustrated with lantern slides, are addressed to students of the University and to others interested in the subject. Admission free, without ticket.

ROYAL SOCIETY OF ARTS.

John Street, Adelphi, London, W.C.2.

Wednesday, May 7th, at 8 p.m.—(Ordinary Meeting). S. K. Ratcliffe : "National Parks." Sir Fabian Ware, K.C.V.O., K.B.E., *will preside.*

Friday, May 9th, at 4.30 p.m.—(Indian Meeting). David Clouston, C.I.E., M.A., D.Sc. : "The Report of the Royal Commission on Agriculture."

Wednesday, May 14th, at 8 p.m.—(Ordinary Meeting). Charles E. Douglas : "Rice Cultivation and Treatment."

Wednesday, May 21st, at 8 p.m.—(Ordinary Meeting).

Wednesday, May 28th, at 8 p.m.—(Ordinary Meeting). Harry Barnard : "The Fatber of English Pottery—Josiah Wedgwood, F.R.S., Potter, Inventor and Man of Science." Frank H. Wedgwood will preside.

NOTICES.

MANCHESTER MUNICIPAL COLLEGE OF TECHNOLOGY.

RESEARCH SCHOLARSHIPS IN TECHNOLOGY.

The Governing Body offers a limited number of Research Scholarships in Technology. The value of the scholarship will not exceed

£100. These will be tenable during the Session 1930-31 in the College.

Research may be undertaken in any of the following Departments :—

Mechanical Engineering.
Electrical Engineering.
Municipal Engineering.
Applied Chemistry :—
(*a*) General Chemical Technology.
(*b*) Chemistry of Textiles (Bleaching, Dyeing, Printing and Finishing).
(*c*) Dyestuffs.
(*d*) Fuels.
(*e*) Paper Manufacture.
(*f*) Metallurgy and Assaying.
(*g*) Chemical Technology of Brewing.
(*h*) Electro Chemistry.
Textile Industries.
Photographic Technology.
Printing.
Industrial Administration.

Applications must be received on or before 27th June, 1930. Forms of Application and all information may be obtained by written application to the Registrar of the College.

SCHOLARSHIPS FOR PART-TIME STUDENTS AND OTHERS.

The Governing Body offers a limited number of Scholarships of a value not exceeding £100 a year. The Scholarships will be open to Part-time Students in the College of Technology, and others who are Manchester ratepayers or sons or daughters of Manchester ratepayers, and will be tenable in any one of the University (full-time day) Courses in the Faculty of Technology.

In the event of there not being sufficient Manchester students available or suitably qualified for the Scholarships, the Scholarships will then be offered to suitably qualified students from outside the Manchester City area.

The Scholarships are offered in the first instance for one year, but the Governing Body of the College is willing to renew the Scholarships for a further period of two years, subject to satisfactory reports on the scholar's work being received.

Students seeking admission to the College are required to have passed the Matriculation Examination of the Joint Board of the Northern Universities, or some examination accepted as equivalent. Candidates should therefore be prepared to satisfy this condition. In the case of non-university and part-time students of the College who submit applications for scholarships, special consideration will be given to the results [illegible] be taken into account in all cases.

Applications must be received on or before 27th June, 1930. Forms of application and all information may be obtained by written application to the Registrar of the College.

Notices of Books.

Reports of the Progress of Applied Chemistry—issued by the *Society of Chemical Industry*. Vol. xiv (1929), compiled by a staff of chemists, and edited by T. F. BURTON. Pages 754. Price to members of the above Society, 7s. 6d. To others, 12s. 6d., postage free. The address of the Society is 46/47, Finsbury Square, London, E.C.2.

This annual vloume maintains its high standard of excellence and it is a mine of information for the practical chemist.

Turning to an important development in chemical engineering, that of the **catalytic production of hydrocarbons** (on page 103), we find the following :— " There is no sign of abatement of the spate of patents in this direction, but still the actually operated processes remain very few in number, and the general cracking situation is not much changed except that there is a steady trend to higher temperature. This movement is clearly explicable when it is realised that high anti-knock spirit results when cracking is carried on at about 600°. In many of the newer patents the aid of catalysis is invoked, and it is becoming more and more difficult to find any material that may conceivably possess catalytic power that has not been protected. Some typical applications of such catalyses may be quoted. According to J. Fohlen (*Chim. et Ind.*, 1929, *21*, 1141; B., 1929, 667), cracked oils and hydrogen, without condensation, are led at ordinary pressure through purifiers at 300-250° to a series of reduced nickel catalysts maintained at 250-170° without external heating; lignites, shales, and other poor or sulphurous starting materials give good results. The purifying agents are similar in composition to the catalyst used, and serve to remove all catalyst poisons; since the removal is an exothermic reaction there need be little loss of heat. In the initial catalyst vessels, the temperature is sufficient to destroy any phenols. Again, R. C. Osterstrom and C. R. Wagner (Brit. Pat. [illegible] tem- the

pipe line being raised from 315-427° to 537° in the shortest possible time. The converter elements are provided with cores of catalytic material, *e.g.*, ferrous or ferric oxide, of cylindrical form, and tapered to provide means for regulating the rate of flow of the vapours.

"In a process claimed by I. G. Farbenindustrie (Brit. Pat., 312,717; B., 1929, 683), high continuous yields of hydrocarbons, etc., containing more than one carbon atom may be obtained from mixtures of oxides of carbon and hydrogenous gases if the catalyst (oxides of iron, cobalt, nickel, etc.) contains 0.4-0.6 per cent. of alkali, calculated as metals. According to the same firm (Brit. Pat., 303,761; B. 1929, 198), readily volatile hydrocarbons are obtained from hydrocarbons of any origin, including tars, by subjecting them to the action of a gaseous halogen hydride at temperatures above 100° in the presence of metals such as aluminium, copper, lead, magnesium, iron, cobalt, chromium, or alloys of these, activated by a solution of a salt of a less electropositive metal, and with or without the addition of a metallic chloride.

"I. G. Farbenindustrie (Brit. Pat., 300,703; B., 1929, 45. *cf* Brit. Pat., 276,001; B., 1929, 8) further claims a catalyst for use in the hydrogenation of carbonaceous materials at elevated temperatures and under high pressures, containing up to 10 per cent. of a mixture of copper and zinc or cadmium, the remainder consisting of boron, aluminium, silicon, vanadium, etc., or their compounds, and a similar claim (Brit. Pat., 275,663; B., 1929, 45) for the use of catalysts composed of metals of the fifth periodic group, or their compounds, together with magnesium or its compounds.

"More attention is being given to the general theoretical considerations that underlie the cracking process. A meritorious attempt has been made by H. A. Wilson (*Proc. Roy. Soc.*, 1929, *A124*, 16; B., 1929, 503), who considers the cracking of hypothetical oils consisting only of paraffins and unsaturated hydrocarbons. Assuming that the oil has been in the reaction chamber long enough for equilibrium to have been established between all the substances present, and that no coke is deposited in the reaction chamber, and applying the results obtained in previous investigations of the chemical equilibrium in mixtures of paraffins and unsaturated hydrocarbons, the fractions of the oil coming out of the reaction chamber as a liquid, vapour, fractions (in weight percentages) for four hypothetical oils having the assumed compositions $CH_{2\cdot1}$, $CH_{2\cdot15}$, $CH_{2\cdot2}$, and $CH_{2\cdot25}$ (corresponding, roughly, to fuel oil, crude oil, gas oil, and kerosene), at temperatures ranging from 400° to 760°, and pressures from 7.5 to 60 atm., are tabulated. It is found that there is good general agreement between the calculated results for the hypothetical oils and the results obtained with actual oils, and it is concluded that the hypothetical oils resemble actual oils sufficiently closely for the theory of the cracking of the former to represent the main features of actual cracking, thus confirming Berthelot's suggestion (*Ann. Chim. Phys.*, 1866, *9*, 445) that approximate equilibrium must be attained in actual cracking operations.

"Of considerable interest to the exponents of the so-called 'liquid phase' cracking is the work of R. H. McKee and H. H. Parker (*Ind. Eng. Chem.*, 1928, *20*, 1169; B., 1929, 83) who have determined the temperatures above which an oil can no longer exist as a liquid, and the critical temperatures for a number of pretroleum fractions, such as gas oils or gasolines, by heating in tubes of hard glass until the meniscus was no longer visible. When an oil contained asphaltic substances in solution, no precipitation occurred if it was heated above the critical temperature. It is shown that many so-called liquid-phase cracking processes really take place with the hydrocarbons present entirely as vapour.

"Reference should be made to papers entitled 'Fundamental factors of liquid-phase cracking' (*J. Inst. Pet. Tech.*, 1928, *14*, 761; B., 1929, 84, *cf. B.*, 1927, 576), and 'The cracking process' (*Ber.*, 1929, *62*, 658; B., 1929, 383, *cf.* B., 1929, 84) both by A. N. Sachanen and M. D. Tilitscheyev."

The above serves to show the treatment of subjects which are engaging the attention of chemists throughout the world.

"B." above refers to the *British Chemical Abstracts*.

The headings under which many subjects are grouped are as follows :— General Plant and Machinery, by R. Edgeworth-Johnstone; Gas Carbonisation, Tar, and Tar Products, by H. Hollings and W. A. Voss; Mineral Oils, by A. E. Dunstan; Colouring Matters and Dyes, by Cecil Hollins; Fibres, Textiles, Cellulose, and Paper, by J. C. Withers; Bleaching, Dyeing, Printing and Finishing, by L. G. Lawrie and N. Chap-

liams; *Glass*, by H. W. Howes; *Refractories, Ceramics, and Cements*, by Walter C. Hancock; *Iron and Steel*, by C. O. Bannister; *Non-Ferrous Metals*, by Alan R. Powell; *Electrochemical and Electrometallurgical Industries*, by H. T. S. Britton; *Oils, Fats and Waxes*, by T. P. Hilditch; *Paints, Pigments, Varnishes, and Resins*, by members of the Oil and Colour Chemists' Association; *Indiarubber*, by H. P. Stevens and W. H. Stevens; *Leather and Glue*, by D. Woodroffe; *Soils and Fertilisers*, by E. M. Crowther; *Sugars, Starches, and Gums*, by Lewis Eynon and J. Hy. Lane; *Fermentation Industries*, by H. Lloyd Hind and F. E. Day; *Foods*, by L. H. Lampitt; *Sanitation and Water Purification*, by J. H. Coste; *Fine Chemicals, Medicinal Substances and Essential Oils*, by Edgar Stedman; *Photographic Materials and Processes*, by F. M. Hamer.

Mica. By H. S. SPENCE. Under the authority of the Deputy Minister of Mines, Ottawa. This extensive work of 142 pages may be obtained from the Director of Mines Branch, Ottawa, Canada, for 30 cents. 1930.

Canada possesses important resources in mica, a mineral that, on account of its superiority as an insulating material has, as is well known, come to be indispensable to the electrical industry.

Both of the commercial varieties of mica —termed by the trade, *amber mica* and *white mica*—occur in Canada; the deposits of the former are the more important. The occurrences of amber mica are found chiefly in those parts of Ontario and Quebec contiguous to Ottawa, and within a radius of about a hundred miles. This district was formerly the seat of an important mica industry, and up to a few years ago it furnished the bulk of the world's supply of amber mica. Foreign competition in recent years has led to a rather serious falling off in production, but the deposits are by no means exhausted and are still capable of supplying large quantities of mica should readjustment of the present economic situation warrant them being again actively worked.

This comprehensive report (Mines Branch Publication No. 701) deals with Canadian mica and with the mica industry in general. The more important foreign deposits are also described, and information is given on methods of preparation for market, the manufacture of mica products, utilisation of waste mica, mica grinding, marketing, etc.

two maps showing the location of mica mines and occurrences in the Ontario and Quebec fields. This report is drawn up without regard to expense and the illustrations are in themselves works of art.

Veroffentlichen aus dem Kaiser Wilhelm-Institut fur Silikat forschung in Berlin-Daklem. Vol. 3. Pp.234. Brunswick: Vieweg & Sohn. 1930. Price 36 marks.

The third volume of *Researches* on the silicates, issued from the K.W. Institute under the editorship of Prof. W. Eitel, contains eleven contributions all of which have previously been published in German Scientific journals within the past year. Noteworthy among these are Lang's experiments on the colouring of ruby and sapphire glasses with gold and Klever and Kordes' colorimetric study of the de-hydration of kaolin.

The concluding paper is an excellent X-ray study of the double carbonate of the alkali and alkaline earth metals.

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THEORY.

Facts are tools with which we dig, and theories are the plans that tell us where and how to dig. Therefore one must not despise either theories or facts, for, broadly speaking, they are both tools for the advancement of knowledge.

Industrially there may be more money made out of theoretical investigations *than out of pure-fact investigations* where theory plays no part; but this statement needs qualifying. The word *may* suffices for this purpose because it implies that there are cases in which the non-practical work gives rise to great industrial activity. It must be remembered that *industry* is a far-reaching word, as it implies *activities in the most remote quarters which* are not thought of at first. For example, the publication of the literature on the theory or relativity gave work to thousands.

Again, a study or pure-science investigation, that seems remotely removed from practical affairs, in time may give rise to activities of the greatest benefit to the working classes. It is very difficult to judge properly of these matters.

Misdirected effort, however, should be guarded against, as one may spend a great deal of time and even money either in trying to do the impossible, or in accomplishing something that in the end proves to be wholly worthless.

It generally happens that those who sit in judgment and pronounce hard and fast limitations are themselves drifting away from the great advances which are being made, and being then out of touch with the newer world, or shall we say for example, the new physics, they become hopelessly biassed by sheer ignorance. In running away from the new knowledge they have barked up the wrong tree—to use here an American expression.

This does not mean that one should not be critical as regards new theories, but let such critics apply their own power of criticism to their own work or statements first. If they can sufficiently divorce themselves from their own egotism they will then see where they rightly stand in the world's opinion, which after all, is most important as we are all of this world and we cannot live apart from it successfully.

Sermonising is not a profitable business in science, but a little stocktaking and surveying of the attitudes of mind may not come amiss.

It is true that "what one fool can do another can," and it is also true that it is easier to criticise than to construct profitably. Constructive or helpful criticism is good for all souls concerned.

The best test for a statement that reads well in print, or indeed sounds like words from the wise, is to apply it by a process of elimination. Those, for example, who deplore the developments in engineering from a purely self-æsthetic point of view should begin by eliminating the engineering activities one by one. They would then begin to think of the necessity of invention to give employment. In the end they would restore things to the present state and consider other ways of improving matters.

CELLULOSE IN THE LIGHT OF THE X-RAYS.

By Sir William Bragg, K.B.E., D.Sc., F.R.S., M.R.I., Fullerian Professor of Chemistry.

Royal Institution of Great Britain Lecture, William Henry Eccles, D.Sc., F.R.S., Manager and Vice-President, in the Chair.

One of the most fascinating features that emerge during the closer study of natural constructions is surely the extended use of certain atoms, certain molecules, and certain ways of combining molecules; while other atoms, molecules, and combinations are but seldom employed. Thus, for example, half the world of which we have knowledge is made of oxygen : silicon is used to the extent of 27 per cent., aluminium 8 per cent., iron and a few others make most of the remainder, and some eighty or more of the 92 kinds of atoms cannot muster 2 per cent. between them. The seas that cover the larger part of the earth's surface give the water molecule H_2O easy precedence over all others. In the rocks, the oxygen atoms govern the structure : the recent work on the silicates by W. L. Bragg and his collaborators shows us that we may regard the great bulk of the earth's crust as a piling together of bulky oxygen atoms cemented by atoms of other kinds such as silicon, aluminium, iron or magnesium. Sometimes the piling is of the simplest character, and seems to depend for the most part on considerations of space to be occupied. Sometimes, as in quartz, more complicated structures are framed in order to satisfy the directional qualities of the mutual attractions of silicon and oxygen.

If we take special note of the elements of living structure, the extraordinary predominance of the carbon atom at once attracts attention. Though the mass of carbon in the world is only about a fortieth of one per cent. of the whole, its importance to life is extreme.

Two forms of molecular constitution are outstanding : the long chain of carbon atoms which is the basis of so many substances, fats, oils, paraffins, and so on, and the benzene ring in which six carbon atoms are tied together strongly into hexagonal form. A very large proportion of organic chemistry deals with the properties of these two forms of molecules and their derivatives; they are of the greatest importance in regard both to biochemistry and to the chemistry of

Cellulose and Fibres.

Cellulose is the fundamental molecular combination occurring in vegetable growth. One has but to remember that forests and shrubs and grasses and plants of all kinds are mainly composed of cellulose to realise the strangeness of such a particular selection. What is there in the cellulose molecule or combination of molecules that its responsibility should be so great? It is pre-eminently the molecule of growth in the vegetable world. It is found in the animal world also. It must be a molecule by the aid of which purpose and direction can be worked out. A mass of cellulose as it occurs in a plant cannot be of equal properties in all directions, for growth has to take place along definite lines. With one or two stray exceptions, such as asbestos, the bulk of inorganic substances does not display that curious feature which we describe in a word as "fibre."

Cellulose is a fibrous material, and its molecule or molecular combination must somehow give it this fundamental character. The fibrous character of the stem and leaves of plants is their most obvious characteristic : the marked quality of direction is at the basis of their manner of growth and their constructional possibilities. These qualities, moreover, we use for our own purposes. We spin the natural fibres of cotton and hemp, ramie, jute, and the like, forming threads and ropes which have the special quality of standing strain in one direction. We weave cotton goods; and we use the comminuted cellulose to make paper. In these cases the fibres are distributed in one plane in more than one direction, and so form sheets that stand two-dimensional strain. Of late years the cellulose, specially treated in various ways, is drawn out into threads of artificial silk, or rayon. This fibrous quality is therefore essential not only to Nature's employment to cellulose, but also to the use that we make of it. We should like to know exactly what cellulose is, and what there is in the curious structure that justifies this extensive use.

Chemistry of Cellulose.

The main attack upon the question has been made by the chemists, who have found it a simple matter to analyse cellulose into its constituent atoms : it may be described as a multiple of $C_6H_{10}O_5$. But of course this description is quite insufficient to explain its properties : there are, in fact, several other substances of the same composition, such as starch, glycogen, dextrin. The distinctive properties of cellulose must depend on how

respect to one another. We must therefore endeavour to discover the design. It would be quite out of place to attempt a description here of the chemist's attack upon the problem of position. We have already heard, at the Royal Institution, a general account of the atomic positions in the sugar molecule from Sir James Irvine, who has himself been a pioneer in this field. Cellulose is closely allied to the sugars; indeed their basic features are the same. A brief description of some of the chemical results will be quite sufficient for our purpose.

It is certain that the six carbon atoms are connected in a chain. But the chain is not to be thought of as drawn out in a straight line. The chemist writes a formula of a straight line character, when he wishes merely to show which atom is attached to which, but his meaning goes no further. Fig. 1 shows the usual method of writing the formula for glucose, of which the $C_6H_{10}O_5$ group is the anhydrous form.

Each carbon atom is attached to four other atoms : the positions of the hydrogens and the OH groups, right or left of the carbons, have a meaning in that if any pair is inverted the character of the substance changes. The most curious feature of the diagram is the connection of the first and fifth carbon atoms through an oxygen.

Glucose. Cellobiose.

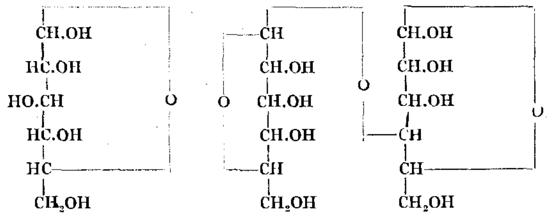

Fig. 1.

Possibly the diagram is wrong in that it should be the fourth that is joined to the first. The latter view was favoured for many years, but later researches, especially by Haworth, make the 1 : 5 junction the more probable, and we will adopt it provisionally.

Clearly, when we come to think of this set of atoms as a group in space, we must make arrangements for the oxygen at the side of the diagram to get into contact with the two atoms to which the formula attaches it. Getting into contact means that the centre to centre distance between two atoms is a quantity which under similar conditions may be considered to be fairly constant. It would be impossible to think of an oxygen touching the first and last of five carbons in a straight line. The chain must be bent round until contact is possible, and at once we have the idea of a six-atom ring, five carbons and one oxygen.

There is no doubt that this ring is the basic element of all living plants and of numbers of those substances which can be

fact stirs the imagination and the desire to investigate the remarkable structure by every means at our command. A similar urge comes from the many industrial enterprises that use cellulose, from the cotton workers of every kind, from the huge concerns that make artificial silk, from the paper makers, from those concerned with celluloid, explosives, certain varnishes, and a host of other things.

It has not been possible so far to go by chemical means much beyond the point already described. The indications become hazy, and the chemists are divided as to their meaning. The most important step is the statement of the formula of the substance called cellobiose which has been derived from cellulose. Cellulose, it will be remembered, is the multiple product of the element $C_6H_{10}O_5$; it is some compound made up of the rings just described, generally known as glucose rings. Cellobiose contains two rings, and the chemical evidence is in favour of combination in the manner indicated, according to chemical conventions,

first carbon of one glucose ring is joined to the fourth carbon of a second ring. [illegible] the process, one oxygen and two hydrogens, the

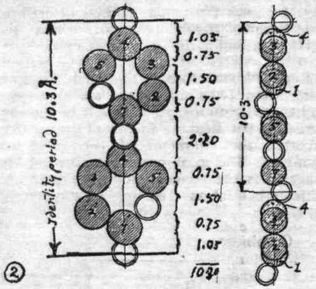

Fig. 2.—*Model of cellobiose. Shaded circles represent carbon atoms; oxygen atoms are drawn as double rings to show the limits between which their diameters probably lie. This model, due to Mark, shows two glucose rings, stripped of atoms unessential for the purpose of showing the method of combination, and joined together by an oxygen to form the kernel of the cellobiose molecule. Two views of the model are shown. It should be compared with* Fig 1.

constituents of a water molecule, have disappeared from the combination. It is further held that by tacking on a third ring with a similar oxygen linkage cellobiose may be extended to form cellotriose, which consists of three rings; and that, finally, by the continued addition of ring, up to an indefinite number, we have the essential structure of cellulose. The actual arrangement in space is probably as represented in Fig 2, but this diagram contains some information which only X-rays could supply. We had therefore better leave the construction at this point and consider the X-ray evidence.

Evidence of X-ray Methods.

Let us remember that the new method of X-ray analysis derives its power from its capacity to detect any regularity of arrangement of atoms or molecules. To such dispositions it is very sensitive : it can record a perfect array of a few hundred molecules or so, or an imperfect array if the number is greater.

We have seen that there must be in cellulose some directed quality, if it is to play so important a part in growth as it appears to do. Of course, it may be said that direction is possibly attached as a property to some other constituent of the plant, the identity of which is yet unknown. But, on the other hand, cellulose is common to all plants, and their most prominent content; on the other, it turns out, as will appear, that it is easy to understand how cellulose can have the quality that we look for. Now we cannot imagine how direction is to be obtained without regularity of arrangement. There must be a pattern, involving the constant repetition of some form of grouping, which we might expect to be related to the line of growth. We might then look at once for some such effect when an X-ray is sent through a fibre of cotton or ramie or hemp, as we have become accustomed to find when X-rays act on a photographic plate after traversing a crystal. A crystal is merely a crowd of atoms in regular array.

When the experiment is made, the effect is found at once. Moreover, it is a kind that we recognise as indicative of fibrous nature. Let us look at this point a little more closely.

When a pencil of homogeneous X-rays passes through a crystal which is made to revolve about an axis, one set of crystal planes after another comes to its proper angle for reflection, and the reflected ray leaves the crystal in a direction inclined to the primary pencil at twice the reflecting

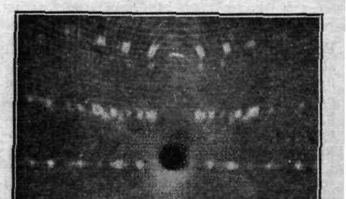

Fig 3.—*Asparagine. X-ray diagram, obtained by W. H. George using the "rotation" method. The X-rays are monochromatic, and the crystal is rotated during the exposure. The network at the back of this diagram is placed there for convenience of interpretation.*

angle. We must remember that all the lattice points in the crystal, that is to say, points representing all the units of pattern, can be looked on in an infinite number of ways as lying on sets of parallel, equi-distant planes. The proper angle for reflection θ is connected with the wave-length (λ) of the rays and the spacing (d) of the planes by the law $n\lambda = 2d \sin \theta$, n being any integer.

A photographic plate may be placed to receive the various reflected rays; and if both rotation axis and plate are perpendicular to the primary pencil, a symmetrical figure is formed on the plate. An example is given in Fig. 3. The crystal was in this case asparagine, which is a derivative of one of the constituents of wool. The weight of the crystal was of the order of a milligram.

From the position of the spots and their intensities the X-ray methods draw information respecting the crystal structure . This is clearly a matter of calculation, based partly on geometry and partly on physical theories as to the reflection process. We do not stop to consider the details. The work of interpretation is by no means easy at all points; but some results can be obtained at once and accurately, others are more difficult and less certain.

The clear separation of the spots on the and horses, and 498 fatal and 4,307 non-asparagine photograph and their arrangement on a few well-marked lines show that the axis of rotation has coincided with an important direction in the crystal; that is to say, a line which passes through many lattice points to the unit of length, and is the intersection of a number of important sets of planes. The lattice points lying on the axis are of necessity equally spaced along it; this must be so in a crystal. The magnitude of this spacing is readily obtained from the photograph. The spots obviously lie on a set of hyperbolæ. If v_n denotes the distance of the vertex of the nth hyperbola from the horizontal line, which is called the equator, and if D is the distance from the crystal to the photographic plate, the spacing in question is equal to $(\lambda \operatorname{cosec} \theta)/n$ where $\tan \theta = v_n/D$. The proof of this rule is to be found in books on this subject. Unless the spots are very hazy, this determination can be made with, at the very least, an accuracy of one or two per cent.

Obviously, if a crystal were made to revolve about three different axes (not coplanar), we should in a similar way find the periodicities in three corresponding directions in space and so determine the form of the crystal lattice.

X-RAY DIAGRAM OF CELLULOSE.

Now if we take some cellulose fibre, such as ramie, and place it so that a fine pencil of homogeneous rays passes through it, afterwards falling on a photographic plate as in the experiment just described, we find that a spot design appears on the plate of exactly the same character as that of the asparagine photograph. It is clear, therefore, that the fibre is in some respects crystalline. There is, however, one significant peculiarity in the manner of obtaining the ramie photograph. It is not necessary to rotate the substance as in the case of the asparagine. The explanation is that the ramie contains not one crystal but many crystals which have in common one important direction; it must be important because the photograph has clear lines. Otherwise the crystals may have any disposition about this line as axis, so that the diagram is like that which a single crystal gives when it is made to rotate.

It will be observed that the ramie photograph (Fig. 4) is not so clear as the other. That is mainly due to the incompleteness of the array of the crystals with respect to each other.

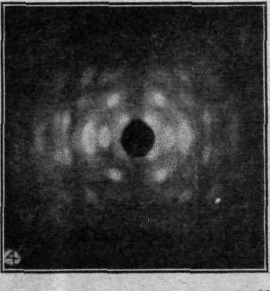

Fig. 4.—*X-ray photograph of ramie fibre.*

Suppose that the disarray were complete, as it would be if the fibrous material were so pounded or otherwise treated that the crystals pointed all ways, there could then be no particular directions on the photograph; no vertical or horizontal lines of symmetry. There could only be a set of rings, as if the fibre photograph were spun rapidly in its own plane about its centre. An example of such a photograph is given in Fig. 5; the material is cystine, one of the constituents of wool. It is due to W. T.

Astbury, of the Textile Research Department at the University of Leeds.

When the spots in the photograph are sharp, we conclude that the crystals are well oriented in respect to one direction, the fibre direction. When there is no orientation at all, the result is as in Fig 5. Every stage between is possible; with a small departure from orientation the spots merely begin to spread along the circles on which they lie.

Some of the blurring is due, however, to the smallness of the crystals. The X-ray action is of the nature of a diffraction, and it is well-known that sharp images denote the combined action of many regularly arranged objects and vice versa. It is even possible to estimate roughly the number of diffracting centres in the crystal from the spreading of the spot. This has been done by H. Mark, whose work on the whole subject is of first importance.

If now we measure the distances of the vertices of the hyperbolæ from the equator in this ramie photograph, we can, as already explained, find the length of the periodicity along the rotation axis. It comes out to be 10.3 A. (1 A. $= 10^{-8}$ cm.).

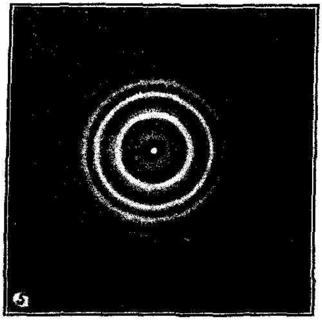

Fig. 5.—Cystine. This kind of diagram, due to W. T. Astbury, is typical of a substance consisting of a multitude of very small crystals, not arranged with respect to each other.

Summing up, we know that:

(1) Cellulose contains crystals which may be invisible in the microscope, but are clearly indicated by the X-rays; they are usually termed crystallites.

(2) These crystallites are partly oriented

(3) In each crystallite there is a periodicity in this special direction of 10.3 A. This is often called the "identity period."

It may not be safe to say that the whole of the cellulose is composed of crystallites, but there is a strong temptation to assume that this is so. Cellulose is a multiple, as regards content, of the unit $C_6H_{10}O_5$, as we have seen reason to suppose that this unit forms a ring which is the basis of the structure. The X-rays do not suggest the presence of a second structure, having any real difference from the first; and we suppose, therefore, that the ring structure pervades the mass. When the X-ray methods become more reliable in the matter of measuring the intensities of the reflection due to a given weight of the substance, in comparison with other substances of similar and known structure, we shall be able no doubt to answer this question conclusively.

Comparison of the Chemical and X-ray Analyses.

We now return to the results of the chemical examination of cellulose and ask how our new results harmonise therewith. As regards the first two deductions stated above, there can of course be no contradiction: we have simply obtained some additional information on the matter of structure. But the third deduction is of rather a different nature. If chemistry has suggested a special arrangement of the atoms, it must show a reason for the periodicity that has been discovered. Now the X-rays have shown us that atoms of carbon and oxygen, when built into the regular structure of crystals, can be said to have dimensions. They do not behave so simply as to warrant our thinking of them as hard spheres. But when the state of combination of two atoms is known, the distance apart of their centres can be stated within limits so close as to give a determining value to estimates of structure.

We know that two carbon atoms bound together in that strong fashion, which is sometimes described as due to the exercise of principal valencies, and is found in diamond, graphite, benzene, hydrocarbons, and the like, are at a distance of very nearly 1.5 A. from one another, centre to centre. We are not quite so sure of the value of the similar distance in the case of oxygen and carbon, but from parallel cases in calcite and elsewhere we can safely assume that it is about 1.2 A. In Fig. 2, due to Mark, an attempt is made to apply these known distances to the determination

about it, because the form of the ring is not yet known accurately. Moreover, the way in which the oxygen bridge is fitted in, while by no means devised *ad hoc*, can only be assumed from analogy with somewhat similar cases in other crystals.

The length of the double ring comes out at 10.3 A., agreeing with the X-ray results. Notwithstanding all its possibilities of error, such a coincidence is most striking. It certainly supports excellently the idea that cellulose is essentially a long chain compound in which the glucose rings form the successive links, being attached to one another by oxygen bridges as shown in Fig. 2. According to Haworth (Constitution of Sugars, p. 84), the unit that is constantly repeated is formed of two rings or links : not of one, which means that the links differ from one another alternately. A difference of this kind is shown in Mark's figure : the oxygen bridges lie, it will be observed, alternately on one side and on the other of the principal plane of the molecule. There is an imperfect repetition of the pattern of each link, and a perfect repetition at each second link. It is known that such a condition should manifest itself in the X-ray diagram by the weakness of the spots in the first, third, and odd numbered hyperbolæ as compared with the strength of the spots in the even numbered. The effect may wear off in the hyperbolæ of high number. The weakness of the first cellulose hyperbola as compared witb the second is very obvious.

Thus the X-ray evidence is certainly, so far, in favour of the conception of cellulose as formed of chains of glucose rings. Throughout the whole length of the chain the bonds are of the strong type such as are found in diamond. The conception has been put forward before (Herzog, *Zeit. ang. Chem.*, 1921, *34*, 385; Polanyi, *Naturwiss.*, 1921, 288), though by no means accepted. It is described, for example, in Haworth's Sugars. The American botanist, Sponsler, who has also used X-ray methods, has maintained it (Colloid Symposium Monograph, 1926). In particular, H. Mark has argued strongly in favour of it, and has supported his views by much experimental research. Nevertheless, there are cellulose chemists to whom the idea does not appeal : Trogus and Hess, for example, have argued against it quite recently.

If we try to estimate the value of such evidence as this, and of much more that will presently be considered, we must recognise that it is not fully decisive. On one hand, there are many factors which are not fully understood; on the other, the X-ray analysis is clearly far from its full development and does not yet handle its problems with the assurance of long experience. But even now the X-ray evidence has a distinct value : it may be expected to be worth much more in the future. In this particular case it is satisfactory to prove a periodicity which a very interesting and promising theory of cellulose would lead us to expect.

The Unit of Pattern of Cellulose.

The diagram has obviously more to tell us than the value of the one periodicity we have been considering. The positions of the separate spots have information to give which goes far to determine the form and dimensions of the unit of pattern. Suppose the unit to be represented by the rhomboidal cell in Fig. 6. The implication of the " cell " is that if we moved our point of view in the crystal from *O* to *A* or to *B* or *C*, we should not be able to detect the change. Suppose that *OB* is the periodicity we have found, which we distinguish by writing 10.3 alongside, all the other dimensions of the cell have yet to be found.

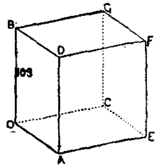

Fig. 6.

Every spot on the equator is made by a set of planes to which *OB* is parallel. For example, the set of planes of which the planes *OBDA* and *CGFE* are consecutive members, contribute one spot to the equator row, and the position of the spot on the diagram gives us the perpendicular distance between the two faces mentioned. So also for the pair *OBGC* and *ADFE*. We may pick out two spots on the equator and decide, as we can with certain limitations which need not be discussed here, that we will make the planes to which these spots belong the faces of the unit cell. But the diagram does not tell us directly what angle these faces make with each other. If we had a single crystal instead of a multitude we should have no difficulty, because we should make a variety of diagrams by revolving the crystal about at least two other directions, such as *OA* and *OC*. It is this lack of the single crystal that most contributes to the difficulty of our task.

Nevertheless, we are not without means which will guide us indirectly, if less cer-

tainly, to a conclusion. To begin with, the general appearance of the diagram considered in comparison with others of like origin suggests strongly that the crystal is nearly if not quite monoclinic. In other words, the direction of periodicity *OA* and *OC* are nearly if not quite perpendicular to *OB*. We may safely assume for the present that they are so. For brevity's sake I do not argue this out in full. If this is assusmed, we have but one unknown left, namely, the angle between *OA* and *OC*. To find it we have the perpendiculars from *A* on *OC* and from *C* on *OA*. Also a definite assumption will carry with it the positions of all the other spots on the diagram, and though this is not so liberal in fresh information as it sounds, yet on the whole the determination of the angle is restricted to one or two very distinct possibilities.

Much argument has been spent on the final choice. It appears that all the details of the diagram are well satisfied if it is assumed that $OA = 8.35$A., $OC = 7.9$A., and the angle $COA = 84°$ nearly. We have already determined *OB* to be 10.3 (Mark and Meyer, *Zeit. Phys. Chem.*, B. 2, 115; Andress, *Zeit. Phys. Chem.*, B. 2, 380).

An approximate knowledge of the specific gravity of cellulose is enough to show that this cell contains four of the $(C_6H_{10}O_5)$ groups.

Our picture is now taking shape. We picture these long chains as arranged parallel to *OB* (Fig. 6). If the axis of one chain lies along *OB*, the axes of exactly similar chains lie along *AD*, *EF*, and *CG*. Such an arrangement places the matter of two glucose rings within the six walls of the cell, thus accounting for two out of the four rings. Here calculations based on the relative intensities of various spots come to our aid, and in a manner which can be found in accounts of X-ray methods, tell us there is a chain in the middle of the cell, passing approximately through the centres of the faces *OAEC* and *BDFG*. This accounts for the other two rings.

THE CRYSTALLITES.

We must think, therefore, of the crystallite as composed of these long chains laid side by side like a bundle of sticks. This prompts us to consider next the manner in which the sticks are held together.

Now there is an obvious difference between the forces that bind together the links in each chain and those that bind together the chains themselves. The former are relatively very strong, all of them being of the But the latter are due to the mutual action of carbon atoms the primary valencies of which are satisfied by attachments of hydrogens and of hydroxyl groups. They are more of the nature of the forces that bind molecule to molecule in organic crystals like naphthalene. When naphthalene melts or sublimes, its molecules are separated and these secondary valencies are snapped. But the work to be done is very small in comparison with that which is required to snap the primary valencies in the molecule itself. There are no hydroxyl groups in naphthalene, so that the secondary forces are not so large as those we may expect to find in our present case. But still there must be a very great difference between the forces within the chain and those from chain to chain.

We find internal evidence in the structure of our model which is entirely in sympathy with this view. While the centre to centre distance of carbon acids bound by

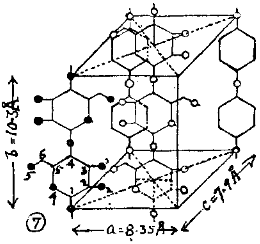

Fig. 7.—*Skeleton diagram showing the relative positions of the chains.* (From Mark and Meyer, *Zeit. phys. Chem.*, B. 2, 122; 1929.)

primary valencies is nearly 1.5 A., the distance of closest approach of carbon atoms belonging to different molecules is about 3.5 A. In graphite, for example, the layers are separated by a distance of 3.41 A. In naphthalene the corresponding distance is about 3.5 A.; in the fatty acids it is the same. If we consider the cellulose model, we see that some such distance must be assumed here also. Otherwise, the chains would not come into contact with each other; they would not fill up the volume. For example, the model shows the planes of the ring lying mainly in the *ab* and parallel planes, as in Fig. 7, due to Mark and Meyer (*Zeit. phys. Chem.*, 1929, B. 2, 122. The

the strongest on the diagram, which is in deed a very important guide to the construction of the model. The distance from plane to plane is 3.95 A., which fits in very well with hypothesis.

Temperature Effects.

A certain measure of confirmation comes from a different quarter. The coefficient of expansion of diamond with temperature is exceedingly small. In the case of graphite it is very small in the plane of the sheets, but many times greater at right angles thereto. (Backhurst, *Proc. Roy. Soc.*, 1922, *102*, 340.) In other words, the sheets do not stretch as the temperature rises, but draw apart from each other.

It is to be remembered that a comparison of X-ray diagrams at different temperatures shows the expansion coefficients in every direction in a crystal. This is possible even when the crystal is microscopically invisible, though the accuracy is not so great as when we have a single perfect crystal that can be handled.

The observations on diamond and graphite suggest strongly that the strong carbon bonds in diamond and graphite stretch or contract very little with changes of temperature, while in the case of the weak bond in graphite there is a very appreciable alteration in the centre to centre distance.

The point is further illustrated by an effective experiment due to Dr. Müller. A comparison of the two photographs in Fig. 8 shows that temperature affects the length of a carbon chain far less than the distance that separates the chains from one another.

No doubt the changes in form which a crystal experiences when the temperature is varied are often complicated and are difficult to interpret. But in these simple cases it seems clear that we are observing a difference in the reaction of primary and secondary valencies.

We might certainly expect very little change in the dimensions along the cellulose chain when the temperature is lowered to that of liquid air. This is exactly what Mark and Meyer have found (*Zeit. phys. Chem.*, B. 2, 127). But there is a considerable change in other directions.

Fig. 8.—*X-ray photographs of a paraffin,* $C_{19}H_{40}$, *at the ordinary temperature (A), and at the temperature of liquid air (B). (Dr. A. Müller.) The lines in the centre are due to the various orders of reflection by the long spacing, which is actually the length of the carbon chain. These are in the same positions in the two photographs. But certain lines farther out are due to the sideways spacings of the chains, and these are considerably shifted by the change in temperature.*

Mercerisation.

The process known as mercerisation, so very interesting from the scientific point of view, and so important industrially, produces notable changes in the X-ray diagram. Yet so many of the original features remain that the new structure is obviously to be regarded as a modification of the old.

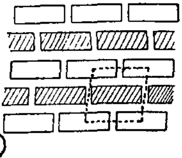

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Fig. 9.—*General disposition of the cellulose chains, looking along the* c *axis.*

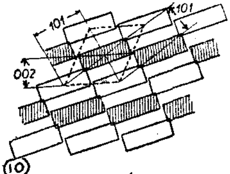

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Fig. 10.—*General disposition of the chains in mercerised cellulose, looking along the* c *axis.*

Most important is the fact that there is no change in the dimensions of the separate links of the chain. Andress (*Zeit. phys. Chem.*, B. 4, 190) has shown that the new diagram can be fully explained if the sideways relations of the chains with respect to each other are somewhat varied, in the manner depicted in Figs. 9 and 10. The new arrangement is regarded as that of the stable form of the crystal, the older as the metastable.

The permanence of the identity period along the chain, and therefore of the chain itself, survives not only a physical alteration such as mercerisation, but also various chemical changes. For example, there are forms of trimethylcellulose, of acetyl-cellulose, and of nitrocellulose, which are crystalline, are of the same general form as cellulose itself, and have the same periodicity of 10.3 in the fibre direction. In other directions there are great changes; clearly the introduction of new atomic groups between the chains must push them apart, though there may be no change in the chains lengthways. When by chemical means the stranger atoms have been taken away again, the original X-ray diagram of cellulose is restored; except that in some cases, depending on the nature of the treatment, the diagram of the recovered material is that of mercerised cellulose.

There are, however, other examples of cellulose derivatives which show a more radical change as the result of chemical action. Another form of nitrocellulose shows, according to Mark, an identity period of 25 A.; and 15 A. has been found in an acetylcellulose and a cuproamine cellulose.

So, in general, the chain seems to retain its nature even when subjected to wide changes of temperature and to many chemical processes. All this is in entire accord with the conception of the chain of glucose rings tied together through its whole length by strong bonds resembling those of diamond: a conception encouraged by the studies of the sugar chemists and now supported by the X-ray evidence. By sideways bonds the chains are tied together into bundles or micelles, and when the chains are long enough these sideways bonds, though individually far weaker than the others and more susceptible to physical and chemical action, will be strong enough to hold the bundle together as a definite element in the structure of the cellulose. The process of the stretching and recovery from strain which fibres show in different degrees and ways owe their many complications to the varied possibilities of gradual alterations in the alignment of the micelles, of their sliding past each other, of their partial recoveries, of their hysteresis, of their final partings when the strain is too great. But these properties of fibre are fully treated in other places.

In fine, we have a striking and in some respects a very simple picture. A particular form of atomic combination has been chosen by Nature to be the basis of all plant structure, and in its essential structure it already embodies the fibre principle. The X-ray analysis at least supports and gives some precision to views as to structure which have already been suggested. There are great possibilities of improvement in the X-ray methods; and it may well be that before long their pronouncements will be much more definite.

THE PROBABILITY LAW FOR THE DECOMPOSITION OF RADIOACTIVE MATERIALS IN VERY SMALL CONCENTRATIONS.

In this Journal on page 262, of this volume, under the title as above, the investigation of G. I. Pokrowski, was noted; and now it appears from the investigation of N. Feather (On the Distribution in Time of the Scintillations Produced by the α-Particle from a Weak Source: *Phys. Rev.*, 1930, *35*, 705-716) that the findings of Pokrowski (see also his later paper, 2nd one, *Zeit. f. Physik*, 1930, *59*, 427-432) are not confirmed, though the matter may not yet be finally settled one way or the other.

The following is Feather's abstract of his paper referred to above:—" The course of radioactive transformation, which in all known cases takes place in strict conformity with an exponential law of decay, is most satisfactorily explained on the supposition that individual atoms disintegrate in complete independence of one another, so that the disintegration throughout an extended source constitutes a perfectly random series of events. Many observations favour this conclusion, but experiments have recently been described showing that at high concentrations (W. Kutzner, *Zeit. f. Physik*, 1927, *44*, 655-683) and also at very low concentrations (preliminary work of Pokdowski) departures may occur. An experiment is here described in which the record of more than 10,000 scintillations produced by the α-particles from a weak source of polonium has been obtained and analysed. A large solid angle was effective, as in Pokrowski's experiments. The various corrections to be applied to the immediate data are discussed, but in the present case they were of no im-

portance. There was no evidence to show that the Marsden-Barratt (*Proc. Phys. Soc.*, 1911, *23*, 367-373) distribution formula was not completely valid under the conditions obtaining. An investigation was also made of intense α radiation on the rate of disintegration in a weak source (Pokrowski), with entirely negative results."

Incidental reference was made in the *Chemical News* (*loc. cit.*, page 262) to the so-called Trans-Neptunian planet. From further data given in these columns (page 279) it will be seen that this body is somewhat of a problem, and it is now referred to as *Lowell's Object.*

To do justice to the present writer it should be noted that on page 262, concluding lines, *uncertainty* with regard to these apparent findings was indicated. It will be interesting to see how these matters turn out as all is not signed and sealed yet.—F.H.L.

TRANS-NEPTUNIAN PLANET.

The atom has been likened to the solar system according to Bohr's well-known theory, although the later developments have thrown considerable doubt upon the scheme of electrons describing orbits round the atomic sun, that is to say, round its nuclear part. Still, planetary matters are of general interest, and the purported discovery of a planet beyond Neptune has excited world-wide discussion as regards the position of this remote body in the solar system, and various schemes for formulating planetary distances have been brought to the fore.

In the *Chemical News*, 1930, *140*, 279, some authentic data were given. In *Nature* (1930, *125*, 649; April 26) the following fuller particulars are recorded :— "*The Lowell Object.* A very remarkable orbit of this object has been computed by the Flagstaff astronomers, and distributed by telegram from Prof. Shapley (*I. A. U. Circular*, No. 271). They find an ellipse with eccentricity 0.909; semi-major axis, 217 units; perihelion distance, 19.64 units; perihelion passage, 1900.5; longitude of perihelion, 12° 52′; ascending note, 109° 21′; inclination, 17° 21′; mean daily motion, 1.112″; period, 3191 years; present distance from sun, 41.8 units. There is no doubt that the present distance and the node and inclination are near the truth, but the eccentricity is stated to be uncertain. If the above value is right, the object would have been of the twelfth magnitude when in perihelion, so that there ought to be little difficulty in finding images of it on old plates. It is advisable to make search in the first place on fairly recent plates, as the limits of error are much smaller; the following short ephemerides have been prepared from these elements; they are for 0 h.

	R.A.			N.Decl.	
1928 Jan. 1	7h.	9m.	11s.	21°	23′
17	7	7	40	21	27
Feb. 2	7	6	15	21	30
1929 Jan. 1	7	15	8	21	39
17	7	13	40	21	42
Feb. 2	7	12	16	21	46

"The uncertainty of these positions is much smaller than that of the elements, and should not exceed a few minutes of arc. All the observatories that search for minor planets are likely to have plates of the region. Rough ephemerides for earlier years can be formed from the annual differences shown above."

From Kepler's law (see for example Russell, Dugan and Stewart's ASTRONOMY (1926 *Vol. 1*, p.265) we see that $1^3 : 217^3 : : 1^2 : 3196.6^2$. The earlier reports were taken to mean a semi-major axis of about 45 units, so that $1^3 : 46.696^3 : : 1^2 : 319.1^2$; but since the period can be calculated from the mean daily motion, as $(360 \times 60 \times 60 / 1.112) / 365.256 = 3191$ years, the about 300-year period is ruler out (for the two proper calculations check each other) if the other values are correct, as they may be assumed to be; that is to say, a decimal-point error is highly improbable as was stated on page 279.

In the *Comptes Rendus*, to use the abbreviated title, of April 25, *vol. 190*, pp. 957-958, Ernest Esclangon gives the following note, reference to a previous communication being inserted in the French text :—

De nouvelles observations du corps céleste dit "planète transneptunienne" ont été faites à l'Observatoire de Paris les 15, 17 19 et 20 avril par M. Mineur qui a obtenu quatre nouveaux clichés. Ces observations sont importantes en ce sens qu'elles se placent après le minimum d'ascension droite de l'astre, le 30.5 mars, et se combinent de manière avantageuse avec celles obtenues avant cette date pour l'emplo i de la méthode rapide de calcul de la position de l'astre que j'ai indiquée précédemment (*Comptes rendus*, 7 et 14 avril 1930).

En utilisant les observations des 16.358 et 27.358 mars et du 17.358 avril, j'ai obtenu, pour la position de l'astre, à la date moyenne du 30.44 mars (temps d'aberration déduit), les coordonnées héliocentriques et la distance R au Soleil suivantes, rapportées à

l'ecliptique et l'équinoxe moyens 1930.0 :

$$X = -13.432,\ Y = +39.464,\ Z = -0.123,\ R = 41.667.$$

En appliquant la même méthode aux observations du 17.000 et 31.00 mars et du 17.853 avril, M. Stoyko, à l'Observatoire de Paris, a *obtenu, pour la date moyenne du 31.379* mars (temps d'aberration déduit) :

$$X = -13.384,\ Y = +39.302,\ Z = -0.121,\ R = 41.519.$$

et, pour les projections de la vitesse de l'astre (vitesse comme on sait mal déterminée, principalement la vitesse radiale),

$Z' = -0.00578,\ Y' = +0.01030,\ Z' = 0.00073$; enfin, pour la longitude du nœud et l'inclinaison,

$$\Omega = 109°16',\ i = 19°38'.$$

La vitesse normale au rayon vecteur, dans le plan de l'orbite serait égale à 0.00228 = 4 km. par seconde.

En partant des mêmes données et appliquant la méthode de Lagrange modifiée par Noumeroff, M. Stoyko obtient pour la date moyenne du 31.379 mars (temps d'aberration déduit) :

$$X = -13.385,\ Y = +39.308,\ Z = -0.121\quad R = 41.524;$$

$$X' = -0.00610,\ Y' = +0.01130,\ Z' = +0.00073$$

et pour la longitude du nœud et l'iuclinaison,

$$\Omega = 109°16',\ i = 19°51'.$$

M. Mineur, par une méthode analogue, a trouvé R = 41.3 pour la même date.

La vitesse normale au rayon vecteur est trouvée ékale ici à 0.00226 = 3.9 km. par seconde. Partant de cette donnée, on pourrait en déduire une limite inférieure de l'excentricité égale à 0.27 mais étant donnée l'incertitude sur la vitesse, ce nombre n'est encore susceptible que d'une confiance relative.

Quoi qu'il en soit, on voit que les limites obtenues pour la distance de l'astre au Soleil se resserrent considérablement au fur et à mesure que se prolongent les observations qui vont être malheureusement interrompues prochainement; la planète se rapprochant du Soleil dans le ciel.

L'excentricité reste pour le moment l'élément plus inaccessible; quant à l'inclinaison, il semble bien qu'elle soit relativement grande, supérieure à 15°.

The question to be raised is : is this body a planet at all?

We do not propose to discuss the matter here, but those interested in planetary studies will find some instructive matter in a series of articles by Loring in this Journal as follows :— 1928, *136*, 225-229; 387-388; 276-277; *137*, 33-37; 129-132.

PAPER FROM EUCALYPTS: ITS DEVELOPMENT IN AUSTRALIA.

Now that the production of paper from Australian timbers is apparently about to commence on a relatively large scale, an account of the steps leading up to that development is appropriate. The matter is also of interest in that the research work carried out in Australia has led to revolutionary practices in paper making countries like America, and to the destruction of an old fallacy, *viz., that only the longer fibred hard* woods (from coniferous trees) could be used to make good quality papers.

Previous attempts to use hardwoods, in which class the Australian eucalypts of course fall, resulted in low yields of difficulty bleachable pulp which was also believed to yield only weak sheets because of the shortness of the fibres. Hardwood fibres are about 1 mm. in length, whereas those of the softwoods are from two to three times as long. It has, however, now been demonstrated that, by suitable treatment, hardwoods can be made to give high yields of easy bleaching pulp, which again, by appropriate conditions of treatment, can be con verted into high-class papers of almost any quality.

The workers in Australia who unravelled the problem of hardwood paper began with no knowledge of the industry, and an open mind which had no prejudice to overcome. In the process of paper-making, the wood is chipped and subjected to the action of certain chemicals in order to dissolve those substances which bind the tiny fibres into hard bundles. It was easy for the idea to grow that hardwood chips needed more severe chemical treatment than softwoods. As a *matter of fact the reverse is, generally speak*ing, the case, and it was the failure to recognize this that led to poor results in early experiments. The paper-making industries of the world had been developed in softwood countries, and a technique gradually grew up suited to such woods. Experts failed to modify this technique in the right direction when trying hardwoods.

From time to time, various workers in Australia have examined a variety of timbers for their paper-making qualities. The investigations in almost all cases consisted of a determination of the percentage of cellulose in the material, and in the measurement of the fibres. In a few cases material was pulped and made into sheets of paper. In New South Wales, a bulk trial was made with several tons of wood, but the paper made was of no value. Because of these ex

periments, several people have claimed priority in the manufacture of paper from hardwoods. In no case was any attempt made to modify the recognized processes of pulping, beating, and bleaching so as to give high yields of easy bleaching pulp that could be made into high quality papers, nor was any investigation made as to the comparative economics of the processes with hard as against soft woods. Until both these steps were taken, it was not possible to lay the foundations of a paper-making industry.

In 1914, the Tasmanian Government brought out Mr. Henry Surface of the United States Forest Service in order that he might test Tasmanian woods. He condemned them as paper-making materials. In 1916, the first attempt at a comprehensive attack on the hardwood paper problem was begun by Mr. I. H. Boas at the Perth Technical School as a result of a suggestion made to him by M. Mathey, Conservator of Forests at Dijon, through Mr. Lane-Poole, then Conservator of Forests in Western Australia. At that time, hardwoods were regarded as practically of no value for paper-making. At first, trials were restricted to the soda process, and by suitable modifications of existing practice, it was found that surprisingly high yields of easy bleaching pulp could be obtained. The work was continued under the auspices of the former Advisory Council of Science and Industry, with the assistance of Mr. L. R. Benjamin, until it became clear that the main factor preventing the use of hardwoods was prejudice.

In 1929, Mr. Boas attempted to interest paper makers in various countries in these trials with no success, though the facts were easily verifiable. The one exception to this general condemnation was M. Vidal, of the Paper School at Grenoble in France, who had himself begun experiments on immature bluegum (*Eucalyptus globulus*) grown in the South of France.

In 1920, with the aid of a model paper-making machine purchased with a grant made by the newspapers of Western Australia, and of a model beater loaned by the Australasia Paper and Pulp Co., the work was continued in the former Forests Products Laboratory at Perth. In 1921, when Mr. Boas resigned, Mr. Benjamin carried on the work, and continued under the present Council for Scientific and Industrial Research. To Mr. Benjamin and his co-workers is due the credit for developing the processes technically up to the semi-commercial scale until all the ordinary methods of pulp- [illegible] well known, all these investigations have now been taken over by the Tasmanian Paper Pty. Ltd.—a concern established by Broken Hill mining interests, to engage in the commercial production of paper in Australia.

Reports of all this work were sent to various research stations abroad, and some of these confirmed the results obtained in Western Australia. The Forest Products Laboratory at Madison, Wisconsin, in testing eucalypt timbers from Brazil in 1927, used the schedules evolved by Benjamin. In 1928, the same laboratory used his schedule in a co-operative investigation with officers of the New Zealand Fosest Service in testing New Zealand woods. Meanwhile, the paper position in the United States had become very serious, and larger quantities of Canadian pulp had to be imported. This turned the American papermaker's thoughts to hardwoods, and here the work done in Australia came in and showed the way. American investigators at Madison went still further and developed the latest semi-chemical process, and the use of the rod mill in beating. These made a tremendous step forward in the hardwood-paper industry, which is now being established elsewhere on a firm basis, and which is going through its initial stages in Australia at the present time.

That the work begun in 1916, not having reached its commercial development in 1928, is but an instance of the difficulties attendant on the determination of the technical and economic basis of an industry which needs the expenditure of millions of pounds before it can be established.—(*From the Journal of the Council for Scientific Research*, 1930, *pages* 57-58.)

ELECTRICITY AT MINES: DAILY LOG BOOK.

The Secretary for Mines recently received representations to the effect that the official edition of the Daily Log Book (M. & Q. Form 10), required to be kept at mines where electricity is used, does not provide sufficient space for adequate reports in the case of large or complex electrical installations.

He has therefore arranged with H.M. Stationery Office for an alternative edition of this book to be issued, in which the space available for reporting has been doubled, and he hopes that this new edition which will be known as M. & Q. 10A, will be found useful by the owners and managers of mines where electricity is extensively employed.

COAL SAVING ON MINE BOILER PLANTS.

An Interesting Example at Middlesborough.

The importance from the national point of view of utilising for steam generation all the available low grade material at mines and similar establishments is well illustrated by the North Skelton Mine at Middlesborough of Messrs. Bolckow & Co. Ltd.

This has three standard " Lancashire " boilers 30ft. x 8ft., feed water economisers, and a chimney 140 feet high, using originally good grade lump coal, "Shildon Lodge" unscreened. However, the boilers were subsequently equipped with " Turbine " forced draught furnaces, hand fired as before, with the result that all the Shildon Lodge coal has been released for sale and "Pond Duff" from the washery plant now used instead.

Very interesting are the detailed results of a series of 8-hour tests carried out on the plant by the mines staff themselves, first under the ordinary conditions with lump coal, and, secondly, when equipped with the forced draught furnaces burning Pond Duff. It may be stated that the latter has a heating value of 9527 B.Th.U. per lb. and contains 21.1 per cent. moisture, and 13.4 per cent. ash, while the Shildon Lodge lump coal is 12810 B.Th.U. per lb. with 5.7 per cent. moisture and 8.8 per cent. ash.

Under the very careful test conditions, representing a series of normal 8-hour runs as stated, the total water evaporated with the Shildon Lodge coal and natural draught was 118,030 lb., that is 4,918 lb. per boiler per hour, the steam pressure being 50 lb. per sqare inch, the feed water going into the economisers at 165° F., and the CO_2 in the gases 7.5 per cent. This corresponded to 8.43 lb. of water evaporated per lb. of coal, and a boiler plant efficiency of 65.8 per cent. while the total coal burned during the 8 hours was 14,000 lb., the output of the mine at this period in tons of coal per day being 1,074. Also the cost of fuel burnt on the boiler plant per ton of mine output was 1.220d., taking the average price of Shildon Lodge coal at 16s. 9d. per ton.

As against this the boiler plant with Pond Duff and forced draught showed a remarkable improvement. Thus, the water evaporated in 8 hours was 152,400 lb., corresponding to 6,350 lb. per boiler per hour under somewhat similar conditions of 195° F. feed water to the economisers and 285° F. leaving the economisers, and 52 lb. steam pressure. The CO_2 however, was 9.0 per cent., while the feed water evaporated per lb. of coal was 6.70 lb., the boiler plant efficiency 71.60 per cent. Further the steam pressure was kept up to the fullest extent, so that in fact the mine output of this particular test was 1,424 tons per day, that is an increase of over 30 per cent., while the cost of coal burnt on the boiler plant per ton of mine output was 0.575d., the price of Pond Duff being taken as 6s. 9d. per ton, which incidentally seems rather a high figure for such low-grade material.

Here, therefore, we have a saving of over 50 per cent. on the coal bill, apart from the other advantages indicated, another example of the value of arranging a boiler plant to burn almost any kind of material, whether of high or low quality, and operating under conditions which produce steam at the cheapest possible nett rate.

LARGE NEW CONCENTRATING MILL AT ERRINGTON MINE. NORTHERN ONTARIO LEAD-ZINC INDUSTRY.

According to the " Northern Miner " Toronto) the Treadwell-Yukon Company, Ltd. has prepared provisional plans for placing the Errington Mine near Sudbury, Ont., on a producing basis for 1,000 tons o fore daily. Large-scale proUduction is dependent upon the quantity of ore exposed on the 15,000-foot level, but by summer it is expected that the deeper ore situation will be known. The contemplated expansion at the mine involves not only the increase of mining and milling capacity up to 2,000 tons of ore per day, but the production of copper, zinc and lead for refining in the vicinity of Sudbury. The execution of these plans would bring into existence a plant rankink as the third largest metallurgical industry in Ontario. The Company is so confident that deep level work will have the expected results that the Provincial Government has been notified that upwards of 28,000 h.p. of electrical energy will be required by next year if the project matures. It is considered quite probable that the investment in mining, milling, smelting and refining works would reach as much as $10,000,000.

The Errington mine is well known as a very large copper-lead-zinc ore-body, on which development has been progressing for the past two or three years. It is understood that on the 500-foot level there is exposed 73,000 square feet of stoping area not including any ore that has not already been

opened up in stopes. The construction by the Canadian Pacific Railway last year of a six-mile branch line to the property from Chelmsford enabled the owners of the mine to effect regular consignments of concentrates from the 300-ton pilot mill which has been erected to test out commercially the reduction of the complex ores. The No. 2. shaft of the mine has been sunk about 900 feet, and last year, diamond drilling was carried on to depths below 1,600 feet.

Proceedings and Notices of Societies

ROYAL INSTITUTION ANNUAL MEETING.

The Annual Meeting of the Members of the Royal Institution was held on Thursday afternoon (May 1), Sir Robert Robertson, Treasurer and Vice-President, in the chair. *The Annual Report of the Committee* of Visitors for the year 1929, testifying to the continued prosperity and efficient management of the Institution, was read and adopted. The Report of the Davy Faraday Research Laboratory Committe was also read. Fifty new Members were elected during the year. Thanks were voted to the President, Treasurer and Secretary, to the Committee of Managers and Visitors, and to the Professors, for their valuable services to the Institution during the past year. The following gentlemen were unanimously elected as Officers for the ensuing year—*President*, The Duke of Northumberland; *Treasurer*, Sir Robert Robertson; *Secretary*, Major C. E. S. Phillips; *Managers*: A. Chaston Chapman, Ernest Clarke, Sir James Crichton-Browne, W. H .Eccles, W. Vaux Graham, Sir Herbert Jackson, Sir Lawrence Jones, V .Warren Low, Colonel Sir Henry Lyons, Sir Henry Miers, Hon. Sir Charles Parsons, Clifford C. Paterson, Robert W. Paul, Lord Rayleigh and W. J. Tennant; *Visitors*, Colonel N. T. Belaiew, Frederick H. Berryman, C. V. Drysdale, Montague Ellis, G. E. Gask. David Heron, G. W. C. Kaye, Percy J. Neate, A. O. Rankine, F. H. Rayner, Hugh Munro Ross. T. C. Sandeman, Harold R. D. Spitta, Alfred E. Western and Robert S. Whipple.

THE OPTICAL SOCIETY.

A meeting of the Optical Society was held at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7., on Thursday, May 8, at 7.30 p.m. The following papers were presented and discussed :—

The Wedge Sector for Quantitative Spectrum Analysis. By F. TWYMAN, F.R.S., AND DR. F. SIMEON, B.Sc.

On the Diffraction of Light by a Slit. By E. T. HANSON, B.A.

Demonstration.—*A New Ophthalmoscope.* By E. F. FINCHAM.

[We understand that the second paper may not have been read. We go to press too early to correct here if necessary.]

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

11,830.—(I. G. Farbenindustrie Akt.Ges.). —Manufacture of ammohdroxaryltriazines. April 14.

12,111.—(I. G. Farbenindustrie Akt.Ges.). —Manufacture of a-napthol. 16 April.

12,228.—(I. G. Farbenindustrie Akt.Ges.). —Manufacture of quinoline derivatives. April 17.

12,242.—(I. G. Farbenindustrie Akt.Ges.). —Manufacture of N-methyl compounds of the pyridine series. April 17.

Specifications Published.

303,901.—(I. G. Farbenindustrie Akt.Ges.). —Process for the manufacture of hydroxy carboxylic acids of carbazole.

306,046.—Jost, F.—Production of alkali nitrates.

327,830.—Impe ial Chemical Industries Ltd. and Kenner, J.—Manufacture of m-2-xylidine.

Abstract Published.

325,968.—Separating hydrogen from gaseous mixtures.—(I G. Farbenindustrie Akt.-Ges.; Frankfort-on-Main, Germany.

Hydrogen is separated from gaseous mixtures by washing under increased pressure and at elevated temperature with a liquid, the solvent power of which for hydrogen increases with rise in temperature. The hydrogen may be recovered from the solution

by a subsequent reduction of temperature or pressure or both. Suitable solvents are tar oils, mineral oils, or fractions thereof used at temperatures of 100-200° C. and pressures of 50-100 atmospheres. Materials to be destructively hydrogenated may be used as solvents and the solution is then hydrogenated without separation of the hydrogen.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

BURMOL.

509,651.—All goods in class 1 which includes chemical substances used in manufactures, photography, or philosophical research, and anti corrosives.—I. G. Farbenindustrie Aktiengesellschaft, Mainzer Landstrasse 28, Frankfort-on-Main, Germany. April 9th. (By Consent).

VINAROL.

511,069.—Chemical substances in Class 1, for use as dressing and finishing agents in the manufacture of textile fabrics.—I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28, Frankfort-on-Main, Germany. April 23rd.

SELO.

509,756.—Photographic chemical and sensitised cinematographic and photographic films and plates. — Selo, Ltd., Selo Works, Woodman Road, Warley, Brentwood, Essex. April 23rd. (Associated.)

BOUISOL.

511,257.—Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes. — Einstein's Electro Chemical Process, Ltd., Cockpit House, 38, Old Queen Street, Westminster, London, S.W.1. April 23rd.

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A BRIEF OUTLINE OF THE HISTORY OF SCIENCE.

By J. G. F. Druce.

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ESTIMATION OF CHROMIUM IN CHROMITE.

By K. BRADDOCK-ROGERS.

(John Harrison Laboratory of Chemistry—University of Pennsylvania.)

The use of sodium peroxide for the decomposition of chrome ore and the oxidation of the chromium was suggested by Hempel (*Z. anorg. Chem.*, 1923, *3*, 193). The suggestion was immediately acted upon by Clark (*J. Chem. Soc.*, 1893, *63*, 1079), who studied the method and recommended it. He stressed the fact that boiling was sufficient to decompose the excess sodium peroxide and that this must be done for a successful analysis. Clark gave full details of the procedure with the result that his recommendations have been found to be basically correct. Rideal and Rosenbloom (*J. Soc. Chem. Ind.*, 1895, *14*, 1017) intensively studied the progress and compared this new method with a previous one. They likewise stressed the importance of boiling to decompose the excess of the sodium peroxide. Very shortly after that Santer (*J. Soc. Chem. Ind.*, 1895, *15*, 155) took exceptions to these recommendations, but after much discussion on both sides the results of the former investigators were substantiated. A few months later Waller (*J. Soc. Chem. Ind.*, 1895, *15*, 436) gave his impressions of the method and upheld both Clark and Rideal and Rosenbloom.

In the more recent investigations on chromite the decomposition of the excess sodium peroxide is likewise emphasised. Low (TECHNICAL METHODS OF ORE ANALYSIS, pp. 71-2, 9th Edition; John Wiley & Son), Treadwell and Hall (ANALYTICAL CHEMISTRY, vol. 2, p. 549c, 7th Edition; John Wiley & Son), Scott (STANDARD METHODS OF ORE ANALYSIS, p. 164a, 4th Edition; Van Nostrand Co.), and Hanks (*Mining Sc. Press*, 1918, *117*, 654), state that the excess sodium peroxide must be decomposed by boiling. On the other hand Cunningham and McNeill (*Anal. Edition J. Ind. Eng. Chem.*, 1929, *1*, 70), leeched the melt with warm water and acidulated the melt with 60 ccs. of 1 : 1 H_2SO_4, as does Meir (*J. South African Assn. Anal. Chem.*, 1916, *2*, 9). The author has followed their recommended procedure in an attempt to compare it with the two methods under discussion in this paper. On acidulation of the melt without previous boiling hydrogen peroxide was liberated which caused reduction of the bichromate and that of course necessitated the re-oxidation of the chrom-

ium. Waller (*loc. cit.*) described the changes very clearly which have been completely corroborated in this laboratory. The author can see no advantage in deliberately reducing the oxidised chromium necessitating re-oxidation with ammonium persulphate as directed by Meir and by Cunningham and McNeill (*loc. cit.*).

Decomposition of the Mineral.

The mineral was ground to pass through a sieve of 200 meshes to the inch. A weighed portion of the dried and ground mineral was fused with eight to ten times its weight of sodium peroxide in a covered nickel crucible. In the fusion the suggestion which appeared in Treadwell and Hall (Vol 2, p. 675, 5th Edition) was followed. The nickel crucible was placed in a sillimanit crucible of such size that the bottoms of the two crucibles were 3-5 mm. apart. This treatment of the crucible prevented too rapid decomposition of the peroxide, prevented excessive heating of the products of the decomposition with a subsequently greater ease in leeching the melt. On the other hand the time of fusion which was 10-12 minutes was somewhat longer than when heat was applied directly to the crucible. Experience showed that the several advantages outweighed the increased length of time of the fusion.

When the melt had cooled sufficiently the crucible and contents were placed in 150-175 ccs. of water, which was heated to boiling to disintegrate completely the melt. The crucible was removed from the beaker, washed with water and the *inside washed with two or three ccs. of 1 : 4 H_2SO_4* and again with water. The lid was washed in the same manner. This small amount of acid will neither liberate sufficient hydrogen peroxide nor neutralise enough alkali to cause reduction of the chromium. The solution was boiled to decompose the excess sodium peroxide (the reduction in volume by boiling of 50-60 ccs. insures complete decomposition of the peroxide) and then cooled somewhat and acidulated with 50 ccs. of 1 : 1 H_2SO_4. The solution was boiled again for several minutes, cooled and diluted. From this point the estimation of the Cr_2O_3 content proceeded by either method.

Estimation of the Cr_2O_3 Content by Means of $KMnO_4$.

The solution which has been prepared as described was diluted to 800-850 ccs. and titrated with standard potassium permanganate and from these values the quantity of chromic oxide in the mineral was obtained. The solutions were prepared and standardised as follows: 35-30 grams of ferrous ammonium sulphate were dissolved in water containing 75 ccs. of concentrated sulphuric acid and the resulting solution diluted to a litre. A .06 N solution of potassium permanganate was prepared and standardised against pure dry sodium oxalate. The ferrous sulphate solution was then standardised against the potassium permanganate.

Electrometric Estimation of the Cr_2O_3 Content.

The apparatus which was used was of the simplest type. A slide wire resistance coil, dry cell, normal calomel electrode, platinum wire electrode, galvanometer, tapping key and stirring dsvice were all that were necessary. The potentiometer arrangement was similar to the one proposed by Hildebrand (Kolthoff and Furman's POTENTIOMETRIC TITRATIONS, 1926, p. 146; John Wiley & Son) except that a voltmeter was not used and a tapping key was inserted between the galvanometer and the solution to be tested. The calomel electrode was the type described by Kolthoff (Kolthoff, *loc. cit.*, p. 139), and the other electrode was a platinum wire wrapped around the arm of the potassium chloride syphon.

The solution to be tested was inserted in the system. The solution was gently stirred and the system was then brought to an electrical balance by adjusting the resistance. The reducing agent, *i.e.*, standard ferrous sulphate, was slowly run into the solution under examination, in this case the dichromate. The appearance of a yellow green colour indicated that the end point was approaching. At about this point the ferrous sulphate was added dropwise and at the same time the circuit was closed with the tapping key. The addition of the reducing agent was continued until a permanent deflection of the galvanometer needle showed that the equivalence point had been reached. A fraction of a drop was sufficient to bring about this deflection.

The ferrous sulphate solution was standardised as follows. A standard solution of potassium dichromate was prepared in the usual manner, *i.e.*, a weighed quantity of the dry salt was dissolved in a definite amount of water. 25 and 50 ccs. samples

m dichromate solu-

cs. beakers, acidu-

lated with 50 cc. of 1 : 1 H_2SO_4 and diluted to 400 ccs. This potassium dichromate solution was inserted into the system, stirred, and electrically balanced as has been described. The ferrous sulphate solution (*qv.*) was run in to an end point. From the Cr_2O_3 equivalent of the standard potassium dichromate solution and from the number of ccs. of the ferrous sulphate solution which was used, the value of the latter in terms of Cr_2O_3 was easily calculated. As a check on the solutions, weighed portions of dry potassium dichromate were dissolved in water, acidulated and diluted. The titration was carried out exactly as described.

Results of the Analysis of Chromite.

	Sample 1.		Sample 2.	
	Electrometric Titration Cr_2O_3	Permanganate Titration Cr_2O_3	Electrometric Titration Cr_2O_3	Permanganate Titration Cr_2O_3
	39.54	39.63	54.77	54.77
	39.45	39.62	54.73	54.75
	39.56	39.59	54.76	54.77
	39.54	39.50	54.77	
	39.54	39.48		
	39.45	39.52		
	39.48	39.64		
		39.57		
Aver.	39.51	39.57	54.75	54.76

It is very evident from this series of analyses that the electrometric estimation of the chromium content of chromite is comparable in accuracy to the well-known and long-used procedure using potassium permanganate. The former method is very rapid with a minimum of handling and preparation of standard solutions. Too great emphasis cannot be made on the decomposition of the excess of sodium peroxide by boiling for a successful analysis.

A PROPOSED ZINC REFINERY NEAR MONTREAL.

The first Annual Report of the Canadian mining and exploration concern known as Ventures, Limited, intimates that a substantial investment has already been made in the site for the proposed zinc refinery to be erected on Ile Perrot in the St. Lawrence River near Montreal, and that power contracts have already been arranged for. This confirms the notification contained in the Annual Report of the Consolidated Mining and Smelting Company of Canada, Ltd., with which concern Ventures, Limited, will be associated in the new enterprise.

PENTAVALENT NITROGEN IN ORGANIC COMPOUNDS.

By Wilder D. Bancroft and C. E. Barnett.

Baker Laboratory of Chemistry, Cornell University.

In connection with some work that we are doing on the constitution of the proteins, it became essential to know in what cases nitrogen in organic compounds would or would not take up hydrogen chloride gas stoichiometrically at room temperature and at atmospheric pressure in order to give what is ordinarily called pentavalent nitrogen.

The following generalisations seem to cover most cases :

I.—The tendency for a nitrogenous compound to react stoichiometrically with hydrogen chloride is increased when hydrogen is replaced by an alkyl group and decreased when hydrogen is replaced by a phenyl group.

II.—Introduction of so-called negative radicals such as O, Cl, Br, NO_2, etc., decreases the tendency of the nitrogenous compounds to react stoichiometrically with hydrogen chloride. These radicals have most effect when attached directly to the nitrogen.

III.—Carbonyl groups attached directly to the nitrogen decrease the tendency of the nitrogen to react stoichiometrically with hydrogen chloride. An aliphatic ethylene carbon linkage acts similarly. For convenience of discussion we shall call two carbonyl groups attached to nitrogen a diketo linkage, a CO group and a C : C aliphatic group attached to nitrogen a keto-ethylene linkage and two C : C aliphatic groups attached to nitrogen a diethylene linkage. Two keto linkages or one keto and one ethylene linkage will destroy the tendency to take on hydrogen chloride unless compensated by the presence of alkyl groups. Since there are not many data at best, we usually mean methyl or ethyl groups when we speak of alkyl groups.

IV.—Two or more nitrogens attached to the same carbon destroy the tendency to combine stoichiometrically with hydrogen chloride for all except one of the nitrogens, except insofar as this may be compensated by the introduction of alkyl groups.

V.—In general, linkage of nitrogen to nitrogen seems to destroy the power of all but one of the nitrogens to combine stoichiometrically with hydrogen chloride, except insofar as this is compensated by the introduction of alkyl groups.

VI.—Hydrogen chloride does not become attached directly to a nitrile nitrogen, an isonitrile nitrogen, or a cyanate nitrogen.

VII.—If the nitrogen is already pentavalent through formation of an intramolecular salt, hydrogen chloride can only be taken up stoichiometrically in case it displaces the other acid.

VIII.—Hydrogen chloride will be taken on additively first to the nitrogen with which it will give the lowest dissociation pressure.

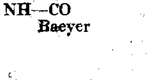
There is nothing new about these generalisations. They have either been made in some form by organic chemists or would be accepted by organic chemists as platitudes. This is the first time, however, that they have been brought together and tested.

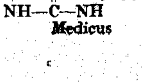
Under I we have the mono-, di- and trialkylamines combining stoichiometrically with hydrogen chloride. The ethylene amines take on as many hydrogen chlorides as there are nitrogens. Tetra-amidobenzene takes four hydrogen chlorides. Triphenylamine does not take on hydrogen chloride, but tribenzylamine does. Pyridine, pyrrol, quinoline, naphthylamine and anthramine take on hydrogen chloride but are weak bases. The corresponding hydrogenated compounds are stronger bases. Dimethylaniline is a stronger base than aniline.

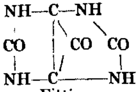
Under II tribromaniline takes on hydrogen chloride; but is a weak base. Nitro groups are more effective than the halogens in decreasing basicity, and dinitroaniline does not take on hydrogen chloride at all. Amidophenol is a weak base and so is phenylhydroxylamine.

Under III we have acetamide and acetanilide reacting with hydrogen chloride, while diacetamide and diacetanilide, succinimide and phthalimide do not react with hydrogen chloride because of the carbonyl groups. Parabanic acid, barbituric acid, dialuric acid, violuric acid, uramil and alloxan do not take on hydrogen chloride stoichiometrically, though each has two or more nitrogen atoms in the molecule.

Three formulæ have been suggested for uric acid :


Baeyer


Medicus


Fittig

The one suggested by Medicus has been universally adopted on chemical grounds. It is interesting to note that the same decision could have been made on the basis of generalisation III, and the fact that uric acid does not react stoichiometrically with hydrogen chloride. In the formula by Medicus the upper lefthand nitrogen cannot react with hydrogen chloride because of the diketo linkage and the other three because of the keto-ethylene linkage. In the Baeyer formula the diketo linkage bars out the left-hand nitrogens; but the first of the right-hand nitrogens would take on hydrogen chloride stoichiometrically. In the Fittig formula two of the nitrogens would be barred under generalisation IV; but uric acid should still be a diacid base.

Under IV we have one of the two nitrogens in urea taking on hydrogen chloride stoichiometrically and one of the three nitrogens in guanidine. Guanazol, with six nitrogens takes only two hydrogen chlorides. Hexamethylene tetramine is an apparent exception, because it has four nitrogens and takes on four hydrogen chlorides stoichiometrically, although each carbon has three nitrogens attached to it. The apparently abnormal behaviour is due to the fact that each nitrogen has three methylene groups attached to it, which compensate.

Under V we have phenyl hydrazine taking on one hydrogen chloride, while ethyl hydrazine takes on two, just as hydrazine itself does, the alkyl group making hydrazine a stronger base and the aryl group making it a weaker base.

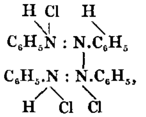
Urazol apparently forms no hydrochloride. It has the formula

CO—NH.NH.CO.NH

and should take on one hydrogen chloride unless we consider the —NH.NH. group functioning as a single nitrogen, in which case all of the nitrogens are barred because of the diketo linkage. Amidoguanidine has four nitrogens but only takes on one hydrogen chloride because the fourth nitrogen is linked to one of the others. Aminotetrazol

H.N.C : N.N : N.NH, has five nitrogens; but only one takes on hydrogen chloride.

Azobenzene, $C_6H_5.N : N.C_6H_5$, is an apparent exception. It should take only one hydrogen chloride and it actually takes on *one and a half*. The formula, however, is undoubtedly



which does not violate the rule, because the third hydrogen chloride is not directly taken by any nitrogen and we are considering only this latter case.

Under VI we find that hydrogen chloride is taken up reversibly and stoichiometrically to hydrocyanic acid, but not to give pentavalent nitrogen. It forms amino-formyl chloride, $H_2C(Cl) :NH$. This substance would undoubtedly take up hydrogen chloride, uniting it to the nitrogen if it did not polymerise. The polymerisation products of the nitriles, isonitriles, cyanates and isocyanates have not been studied with any satisfactory degree of care.

Under VII we find taurine, $NH_2CH_2.CH_2.SO_3H$, and hippuric acid, $NH_2C_6H_5.CO.NH.CH_2CO_2H$, which should each take up one hydrogen chloride but neither does. In the case of taurine, everybody admits the existence of an intramolecular salt

$$\begin{array}{l} CH_2—NH_3 \\ \vert \qquad\qquad >O. \\ CH_2—SO_2 \end{array}$$

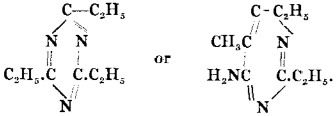
If the same explanation held for hippuric acid, the intramolecular salt would be decomposed if we formed the ethyl ester, and this compound should take up hydrogen chloride stoichiometrically, as indeed it does. Dr. P. A. Levene of the Rockefeller Institute was good enough to give us a sample of glycyl-glycyl glycine, for which we tender him our thanks. We expected that this compound would take up three hydrogen chlorides; but it took only two. On looking the matter up, we found that Emil Fischer had already expressed the opinion that this compound formed an intramolecular compound. This would account for the discrepancy.

Generalisation VII was put in almost as an after-thought to account for the behaviour of succinimidine, which we have not yet tested ourselves. According to the literature this compound takes up only one hydrogen chloride and the formula is written

$$\begin{array}{l} \quad\ \ \ulcorner N(H_2Cl) \urcorner \\ HN : C.CH_2.CH_2.C : NH. \end{array}$$

If we write the formula this way, no more hydrogen chlorides can be taken up because the other two nitrogens are barred under Generalisation IV. If the first hydrogen chloride had been united to one of the end nitrogens as written instead of to the connecting nitrogen, a second hydrogen chloride would have to be united to the nitrogen at the other end. If the literature is right—which we cannot guarantee—the connecting nitrogen must be the most basic of the three. A possible explanation is to be found under Generalisation I, in that this nitrogen is the only one attached to two alkyl groups.

We have come across one other case which may belong here. According to Roscoe and Schorlemmer cyanethine or triethyl cyanuride is a mono-acid base. We can write the formula as



On the first formula, there might be only one hydrogen chloride taken up because the other two nitrogens are attached to carbons which are attached to the first nitrogen. On the pyrimidine formula there should be two hydrogen chlorides unless the first hydrogen *chloride unites to the middle nitrogen*, for which there is no obvious reason. If the experiments are right and if we must adopt the pyrimidine formula, as Sidgwick says, then Generalisation VIII seems the only explanation.

The bearing of this work on the constitution of the proteins lies in the fact that only about thirty per cent. in round numbers of the total nitrogen in gliadin combines stoichiometrically with hydrogen chloride, only about twenty per cent. of the nitrogen in edestin and none of the nitrogen in zein.

If a protein were composed entirely of guanidine derivatives, that would leave only one-third of the total nitrogen availabe for hydrogen chloride but that is not good enough for these three proteins. The so-called peptide linkage, —CONH—, takes up one hydrogen chloride for every nitrogen in all the simple cases tested. Dr. P. A. Levene furnished us with samples of glycyl glycine, which took up two hydrogen chlorides, and

of N-methyl-alanylglycyl glycine, which took up three hydrogen chlorides. Professor John R. Johnson of the Department of Chemistry gave us a sample of glycyl-phenylalanine, which took up two hydrogen chlorides, and reference has been made to Dr. Levene's glycyl-glycyl glycine, which took up two hydrogen chlorides instead of three, presumably because of formation of an intramolecular salt.

The evidence so far indicates that zein contains practically no peptide linkages and our problem is now to determine what nitrogen linkages it does contain.

The general results of this paper are as follows :—

1.—Eight generalisations have been given which cover pretty well the conditions under which organic nitrogen does or does not take up hydrogen chloride stoichiometrically.

2.—About seventy per cent. of the total nitrogen in gliadin, eight per cent. in edestin and one hundred per cent. in zein does not take up hydrogen chloride stoichiometrically.

3.—All nitrogens having the peptide linkage, —CONH—, should take up hydrogen chloride stoichiometrically.

4.—There are apparently non peptide linkages in zein.

(*From the Proc. Nat. Acad. Sci.*, 1930, *16*, pp. 288-293.)

THE PICKLING OF IRON SHEETS.

Interesting Scientific Principles Involved.

An important operation in the metallurgical industries is the " pickling " or cleaning of iron sheets with dilute sulphuric or hydrochloric acid, and the chemical principles involved are interesting and complicated. In general the time required for the operation is 15-30 minutes depending on the state of the sheets. Thus, the best specimens with little scale do not need much pickling, whereas those at the outside of the pack, where most scale is formed, require the longest period. Roughly the temperature in the bath is 140-180° F., and a strength of 2-18 per cent. acid is used for sulphuric and up to 14 per cent. for hydrochloric, while as regards the amount required, an ideal is 1 cwt. of acid per ton of sheets pickled. This, however, is rarely attained in practice, and the normal figure is 1 cwt. 7 lb. to 1 cwt. 1 qr. per ton. It is now the general opinion that hydrochloric acid acts by dissolving the oxide to form chloride and then attacks the metal more or less readily, whereas the action of sulphuric acid is largely " mechanical " the acid getting behind the scale and forcing it off the sheets, the metal being very much less affected. Generally the position to-day with regard to pickling is that hydrochloric acid is more suitable for hand operation with the sheets frequently examined by the operator, but modern works are now more and more adopting mechanical pickling, using sulphuric acid, with the sheets handled completely on the most efficient lines by overhead travelling cranes and lifting gear. The nett result is a great reduction in cost, as much as 6d. per ton in labour alone, and prominent in this field are Craven Bros. (Manchester), Ltd., Reddish, near Stockport, who supply complete mechanical pickling equipment. This includes electric driven overhead cranes, concrete tanks for the dilute sulphuric acid, on massive concrete foundations, lined with acid resisting material faced also with acid proof brick, and acid resisting phosphor bronze " baskets " to contain the sheets, which are lifted bodily in and out of the pickling bath. These baskets weigh about 35 cwt. for 12 feet standard sheets, and take a charge of 20-26 cwt. according to the gauge of the sheets. Afterwards the basket of pickled sheets is washed in water tanks, while the overhead travelling crane is a modification of the firm's " Octopus " type, provided with a special automatic drip tray which comes into operation at the necessary period moving underneath the baskets when the latter are in the highest position and catching all the drippings. The spent acid is mostly neutralised with lime, and when possible allowed to run to waste on tideways or marsh land, and it may be mentioned another advantage of sulphuric acid as against hydrochloric acid is that it is easier to handle in bulk, and the use of carboys is eliminated, this being still the general method for hydrochloric acid.

THE ECLIPSE.

The total eclipse of the sun was observed successfully on April 28th by the Lick Observatory expedition at Camptonville, California. Photographs of the corona and accurate contact times were taken. The corona and the moon's shadow were also photographed exceptionally well from an aeroplane 10,000 feet up.

This eclipse should have afforded a good opportunity of obtaining a flash spectrum; and photographs of the *inner* corona will be also of interest as it is expected that these were successfully taken.

RELATIONS IN THE STRUCTURAL CONSTANTS OF ARAGONITE.

By HAWKSWORTH COLLINS.

Although there are hundreds more collinsics ready to be published, it seems to be necessary to begin to demonstrate by some other means that those relations already published are correct, in order to eliminate the idea in the minds of some readers that there is any jugglery with figures.

A *corroborated collinsic* is one that is strengthened by experimental heat of formation together with the law of H.F., or by experimental data of magnetic rotation together with the law of M.R. It also includes, whenever possible, deductions on the structure of atoms by the law of relative volume.

Table XXIII, which is the corroborated Collinsic II*, shows how the structural constants of aragonite are related.

Table XXIV gives a list of the corroborated voloptics employed in Aragonite and also the number of times each voloptic has occurred in the first 180 collinsics. Table XXV gives the original volume of each atom. Table XXVI gives the H.F. of each atom by the law of H.F.

TABLE XXIV.

	R.V.	*O.R.*	*H.F.*	*Number of Times Occurring*
Calcium	13.25	13.25	59568	26
Carbon	8.0	3.333	-13855	20
Oxygen	7.53	1.654	32341	258
Oyxgen	2.51	1.346	96155	1360

These are intended to be read as follows: When the combining relative volume of Ca is 13.25, its optical refractivity is 13.25 and its heat of formation is 59568, and the same values for R.V. and O.R. have already occurred together 26 times in the first 180 collinsics.

TABLE XXIII.

		Theor. at 15°C.	Obs.	
Aragonite	Ca + C + O + O_2			
20.929 = 0.6192(13.25 + 8	**+ 7.53 + 2.51_2)**	**2.96**	2.938	Brei
			2.995	Brei
		1.6192	1.53013	D.
			1.68157	D.
O.R. **20.929** =	**13.25 + 3.333 + 1.654 + 1.346_2**			
H.F. =	**59568 - 13855 + 32341 + 96155_2 = 270364**		269100	CRPC
			270800	CRPC

TABLE XXV.

	Orig. Vol.		*At. Wt.*		*Theor. S.G.*	*Obs. S.G.*	
Calcium	25.66	=	40	÷	1.56	1.566	Matthiessen.
						1.55	John
Carbon	6.548	=	12	÷	1.833	1.84	Griffith.
						1.80	Playfair (charcoal).

Oxygen 10.07 is the equivalent original relative volume; *i.e.*, it is the relative volume that free oxygen would occupy at 15°C., if it were solid at that temperature.

TABLE XXVI.

LAW OF HEAT OF FORMATION.

The Law.	*Orig. Vol.*		*Combining Vol.*		*Change of Vol.*
-13855 = 795 × (-1.452) × 12	6.548	=	8	-	1.452
32341 = 795 × 2.54 × 16	10.07	=	7.53	+	2.54
71515 = 795 × 5.62 × 16	10.07	=	4.45	+	5.62
96155 = 795 × 7.56 × 16	10.07	=	2.51	+	7.56
59568 = 120 × 12.41 × 40	25.66	=	13.25	+	12.41

The second line of oxygen is included in order to show that 10.07 is the equivalent original volume in all three cases.

* See Collins, *Chemical News*, 1930, *140*, 194-197.

The Structure of an Atom of Calcium.

The structure of Ca was given in the *Chemical News*, 1924, *119*, 95, for many reasons as

$$\begin{array}{c} Na-H-H_3-H \\ | \quad | \quad | \\ Li-H-H_3-H \end{array}$$

where the thin lines denote non-chemically-evident forces, and the thick lines denote the same forces together with combining valences. The significance of this structure can only be appreciated by a study of the papers by the author in the *Chemical News*, 1907, *96*, 176; 1913, *107*, 99; 1913, *108*, 235; 1914, *109*, 26; 1919 *119*, 29 and 295, etc. The chief reason for this structure was the discovery of the Law of the Structure of Non-Metals, published for the first time as an advertisement in the *Chemical News*, 1906, asking for expert opinions. The law is :— *The non-metallic nature of an element* is always due to a pair or pairs of electro-positive forces, each pair emanating from a portion of the element of which the mass is 4, taking the mass of an atom of hydrogen as unity.

The Interrelationships of the Elements.

This was published as a distinct discovery in the *Chemical News*, 1920, *120*, 169. From this Ca can be built up either as K+H, or Si+C. In the formula H is on the right and K(=AlC) on the left. Si is on the top and C on the bottom. The only free portions are H on the right and Li on the left, from which the two valences of Ca emanate. There are several peculiarities with regard to this structure, all of which have been published in the *Chemical News*. One is that each of the eight portions of the formula represents a mass from which it is known that one valence emanates.

This structure is now confirmed by the three Atomic Collinsics given in Table XXVII. An atomic collinsic is an arrangement of figures, obtained from numerous experimental data of other scientists, showing the structure of the atom whilst an ordinary collinsic is concerned only with each atom as a whole.

Of course it would not do for the investigator to produce his own experimental data, for he might be inclined to adjust his experimental data to suit his own hypothesis. This has been done in the past, and there is one especially glaring instance of it in the records of specific gravity .

TABLE XXVII.

Three Atomic Collinsics of Calcium.

	Ca	=	K	+ H
At. Wt.	40	=	39	+ 1
R.V.	13.25	=	7.49	+ 5.76
O.R.	13.25	=	7.49	+ 5.76

	Ca	=	Si	+ C
At. Wt.	40	=	28	+12
R.V.	14.54	=	13.83	+ 0.71
O.R.	10.52	=	9.81 (9.78)	+ 0.71

	Ca	=	Si	+ C
At. Wt.	40	=	28	+12
R.V.	25.66	=	17.66 (17.61)	+ 8

The figures 13.25 have now occurred 52 times in connection with Ca in the first 180 collinsics; 14.54 and 10.52 have each occurred 75 times also in connection with Ca; 7.49, 15 times in connection with K; 5.76, 832 times with H; 13.83 and 9.78 each 54 times with Si; 17.61, 59 times with Si; 8.0, 20 times with C. The last will occur later hundreds of times in organic substances whenever there is a carbon atom united to both valences of an oxygen atom. 0.71 has not yet been included in any of the 180 published collinsics, but it will appear later in almost every one of the thousands of organic substances. It is the relative *volume of a carbon atom when each* valence is united to a different atom.

The two values 9.81 and 9.78 differ by 1 in 327, and the two 17.66 and 17.61 by 1 in 353.

SUMMARY.

The *Collinsic of Aragonite*, which was given in a preceding paper (*Chemical News*, 1930, *140*, 194) is here proved to be exactly true by means of the H.F. of each atom. For the H.F. in each case is calculated by law from the combining volumes and the original volumes

In addition to this proof it is shown that each one of the three values obtained for R.V. and the two for O.R. lead to the conclusion that an atom of Ca has been formed either by the union of one of K with one of H or by the union of one of Si with one of C.

In short, hundreds of experimental results in this and preceding papers have been brought into line for the demonstration of the structure of an atom of calcium.

[Aragonite is of course a calcium carbonate, $CaCO_3$ that is known in a general but misleading way as calcite. Their crystalline forms and densities differ. The pure calcium carbonate in a certain natural crystalline form, known as calcite, has an accurately-determined density, or specific gravity, of 2.7104 at 15°C., with an estimated error of ± 0.0004. See O. K. De Foe and A. H. Compton, *Phys. Rev.*, 1925, *25*, 618. The molecular weight of $CaCO_3$ according to Birge (Physical Constants : *Phys. Rev.*

Sup., 1929, *1*, 1-73) is 100.078, since C= 12.003 ± 0.001, Ca = 40.075 ± 0.005, O being taken as 16 exactly. The sum of the volume-constants above = 33.62. 100.078/33.62 = 2.9761. Collins in the *Chemical News*, 1928, *136*, 305-307, gives *calcite* as having a density of 2.700; the volume-constants in this case being Ca = 14.54, C = 8, O = 7.53, O = 4.45, O = 2.51, so that their sum is 37.03. 100.078/37.03 = 2.7026. This is very close to the best experimental value above. 14.54 is common to other compounds containing calcium as are the other volume-constants used so that no arbitrary constant is involved in these relations.—*Comment added by the* Editor.]

TRANS-NEPTUNIAN PLANETS.

In the *Comptes Rendus*, April 28, 1930, vol. 190, pp. 981-985, M. Esclangon adds a further note (see *Chemical News*, this vol., page 299). The parallactic method which M. Esclangon proposes to determine the position and speed of the Lowell Object is geometrical, and it is based upon the hypothesis that in observations used the speed of a body can be taken as constant and non-changing in direction without the laws of gravity interfering. It is a very rapid method of calculation and applies to the case in point. For full particulars the original must be consulted.

In *Naturwissenschaften* of April 18, 1930, page 360, H. Brück gives some data concerning the Trans-Neptunian planet as follows :— Photographs are shown here taken by Wolf, with the 28-inch reflector of the Heidelberg Telescope, on March 19th and 21st. On these photographs the "Slipher" object is visible and is indicated by an arrow, the bright star to the left of it being one of the 4th magnitude δ Geminorum, mentioned in Shapley's telegram (see *Chemical News*, this vol., p. 299). The movement of the body in two days is clearly seen and viewed stereoscopically it stands out in front of the background stars. Two photographs without arrows are inserted presumably to enable them to be examined stereoscopically.

To an earlier report in this journal (*Naturwiss.*, vol. 14) might be added, that in the meantime numerous observers have advised fresh determinations of position of the planet.

As regards the history of the discovery of the planet Prof. Ludendorff has pointed ont in a friendly manner that in addition to the previously-mentioned work to which may be added that of W. H. Pickering, a short interesting study by Grigull in 1921 appeared in the popular journal *Das Weltall*. Grigull concludes from the existence of a family of comets, of which 6 members have their aphelian all in about 48 units from the sun, that a disturbing planet exists at about this distance. Assuming that the aphelion distance of a comet closely agrees with the distance of the planet at the time of the disturbing influence upon the corresponding comet, and with certain assumptions with regard to the perturbing time, Grigull calculates the movement of the planet and the heliocentric distance. This for the Trans-Neptunian planet for the year 1921 was found to be 85° ± 14°. With this its period of revolution is 320 ± 10 years and its radius of path axis 46.8 ± 1.0 units. These data agree very closely with those of the object observed. According to the calculations, with mean annual movement arising from the period of revolution of 98° for 1930, the mean heliocentric distance of the planet would amount to 95° ± 14° while the object discovered is at 108°.

In *Nature*, 1930, *125*, 721, further particulars are given under the title "The Lowell Planet." It is stated that the eccentricity of 0.9 and period of 3200 years is still very uncertain. Among other statements several orbits according to E. C. Bower and F. L. Whipple in the *Lick Bulletin*, 421, are given : Four ellipses are cited with periods 229, 390, 264, and 264 years. Also two parabolic orbits were considered. It appears that Prof. W. H. Pickering in a letter states that he has found a period of 210 years. *Harvard Announcement Card*, 123, states that Mr. Henroteau and Miss Burland have discovered an object on plates taken at Ottawa in 1924 that appears to be trans-Neptunian, but cannot be the Lowell object, being too far north. The positions are given in *Nature*, from which Dr. Crommelin derives the following circular elements referred to equinox of 1924 :— Distance, 39.82 ; period, 251.3 years ; node, 280° 29.4′ ; inclination, 49° 7′. It is stated that in the case of the Lowell planet the circular hypothesis gave a good approximation to the distance so "it may do so here also."

Sir James Jeans, in the *Sunday Observer* (March 16th) said :—

It is rash to prophesy ; the new planet may not only falsify our predictions, but may even compel us to abandon our present views as to the origin of the sun's family of planets. This is part of the value inherent in its discovery.

THE WELDING OF COPPER.

The satisfactory welding of copper has been a difficulty, owing to the high thermal conductivity of the metal, and it was found that the copper became brittle by the action of the gases in the acetylene flame.

As the result of research work carried out a process for welding copper has now been evolved which renders the operation simple and safe, provided the correct materials are used.

A demonstration of this welding was carried out by the Premier Electric Welding Company Ltd., on Tuesday, April 29th, at the Swansea works of British Copper Manufacturers Ltd., a subsidiary company of Imperial Chemical Industries Ltd.

At this demonstration, copper pipes were welded together without difficulty, and the joint subjected to severe flattening and bending tests, the results of which proved conditions of service as satisfactory as the pipe itself. Sheets of copper were also joined together by the welding process and it was shown that these would withstand a considerable amount of work and stretching, in fact, as much as the solid copper itself could be expected to withstand.

The welding of varnish pot seams was also demonstrated, a process which eliminated a great deal of troublesome riveting. It was observed that the welding operator worked quickly and as easily as if he were merely brazing the pieces together, and after the weld had been made and trimmed, it was difficult to see where the joint occurred, whilst it had a tensile strength equal to that of rolled copper.

All this has been achieved by means of slight modifications in the technique of welding ferrous metals, by the use of copper alloy filler rod, and flux of the appropriate type. The copper which has been developed for welding purposes is not attacked by the gases of the acetylene flame, and it is essential to use this copper if the weld is to be perfectly satisfactory. The copper is a modification of the tough pitch variety, supplied at the same price, but not inferior to it in any way, in fact, it imght be expected to give better service generally. The filler rod again is of specially modified copper, which is very fluid when molten, and so runs full into the joint leaving no air locks or gaps. It is essential to use this filler rod in order to obtain a homogeneous weld. The flux is used in order to hinder the formation of scale on the red-hot copper as the scale prevents good metallic contact being obtained.

Using these materials, which are supplied by Imperial Chemical Industries Ltd., it was demonstrated that with an hour's practice, a welder could acquire the technique of copper welding and produce sound joints as easily as he could with ferrous materials.

NOTE ON CUPRIC IODIDE.

By Frank L. Teed, D.Sc.

Cupric iodide is stated to be incapable of existing, breaking up on formation into cuprous iodide and free iodine. It is undoubtedly an unstable body but can exist in dilute solutions.

When a decinormal solution of barium iodide is mixed with an equal volume of decinormal cupric sulphate solution there is obvious liberation of iodine.

When to 5 cc. of N/10 barium iodide, 50 cc. of water are added, and this slightly under centinormal solution of barium iodide is added to 5 cc. of N/10 cupric sulphate solution previously diluted with 50 cc. of water, there is a precipitate of barium sulphate but no iodine is liberated.

In case there should be any fear that it is suggested that the reaction between iodides and cupric salts is incomplete, it must be mentioned that on the addition of a further un-noted amount of barium iodide, iodine is liberated copiously.

When the barium iodide and cupric sulphate were each diluted to fiftieth normal, there was liberation of iodine, on mixing.

When 5 cc. of N/10 solution of each was diluted by addition of 35 cc. of water to each, there was no immediate liberation of iodine on mixing, but some was liberated on standing.

With 5 cc. of each, both diluted with 40 cc. of water, there was no liberation of iodine at the time, but after 15 minutes a faint trace was found.

In an experiment with lead iodide and cupric sulphate, the lead iodide having been dissolved in hot water with the addition of acetic acid, a solution was obtained, after filtering off the precipitated lead sulphate, containing copper to the extent of 0.026 grammes per 100 cc. This amount calculated as anhydrous cupric iodide was equal to 0.130 grammes per 100 cc., and this determination was made after the solution had stood for several days. This solution contained 0.0018 grammes of free iodine per 100 cc., and mere traces of lead and sulphates. Whether the presence of this free iodine checked the decomposition of the cupric iodide was not decided.

It will be noted that the dilution at which no iodine was liberated when working with

barium iodide and cupric sulphate was N/220, corresponding to 0.144 grammes of cupric iodide per 100 cc., so that somewhere about 0.13 to 0.14 grammes per 100 cc. may be considered as the probable maximum strength of a stable aqueous solution of cupric iodide.

Further additions of either potassium iodide or barium iodide decomposed these dilute solutions liberating iodine.

BIG U.S. CHEMICAL MERGER.

Newport Company and International Printing Ink Corporation Combine.

The merger of two leading U.S. chemical and printing-ink concerns, the Newport Company and the International Printing Ink Corporation, into one company with comcombined assets of over $25,000,000 (£5,00,000), was announced on May 3rd, by Dillon Read and Co., of New York, bankers for both concerns.

The International Printing Ink Corporation, whose activities extend to England, the Argentine and China, is the largest American manufacturer of printing ink and allied products. In adition to nine manufacturing plants in the United States, it controls, through a British subsidiary, Ault & Wiborg Ltd., a similar plant in London.

The Newport Company controls one of the most widely diversified organic chemical enterprises in the United States, operating three manufacturing plants which produce 375 different chemical products. Through its European connections, extensive colour research facilities will be made available to a printing-ink concern for the first time in the history of that industry. The wood distillation division of the Newport Company will not be included in the merger.

Proceedings of Societies.

ROYAL SOCIETY OF ARTS.

A lecture on "Rice Cultivation and Treatment" by Charles E. Douglas, was delivered before the above Society on May 14th, 1930, Sir Edward Davson, Bt., deputy chairman of the British Empire Producers' Organisation, presiding.

THE CHEMICAL SOCIETY OF JAPAN.

Papers communicated :—

A New Hypothesis on Hydroxyl and Carbonyl Radicals of Oxyanthrachinone and its Derivatives. II. A New Method of Synthesis of Xanthopurpurin. By Soai Tanaka and Kiyoshi Morikawa.

A New Hypothesis on Hydroxyl and Carbonyl Radicals. III. Condensation of Napthalic Acid Anhydride and Phenols. By Soai Tanaka and Kiyoshi Morikawa.

Relation between Kolbe Reaction and Hydrogen Ion Concentrations. By Ryoichi Matsuda and Susumu Morita.

Chemistry of Ether. I. By Shigeru Komatsu and Shozo Tanaka.

Velocity of Permeation of Electrolytes through a Membrane. I. Permeation of Alkali Chlorides. By Shinnosuke Matsuura.

Constitution of Primetin. By Willy Nagai and Shizuo Hattori.

Dipole Movement of Molecule and Molecular Orientation at Liquid Surface. By Bun-ichi Tamamushi.

THE PHYSICAL SOCIETY.

At the meeting held at 5 p.m. on Friday, May 9, 1930, at the Imperial College of Science, Imperial Institute Road, South Kensington, S.W.7., the following papers were read :

The Induction of Electromotive Forces in a Moving Liquid by a Magnetic Field, and their application to the investigation of the flow of liquids. By E. J. Williams.

Abstract : A magnetic field induces electromotive forces in a moving liquid and by investigation of the e.m.f.'s produced by a known magnetic field it is possible to obtain information about the distribution of velocities in the liquid. Preliminary experiments on the flow through straight tubes show that potential differences of the order of 10^{-4} to 10^{-3} volts, set up a magnetic field in a moving liquid consisting of an aqueous solution of copper sulphate, can be satisfactorily measured.

The Motion of a Liquid in an Enclosed Space. By E. J. Williams.

Abstract : The increase of resistance of a column of mercury in a magnetic field, found in experiments on this effect, is due to the internal motion of the liquid produced by the action of the ampere forces between the magnetic field and the electric current traversing the mercury. The hydrodynamic significance of the results of such experiments is considered and the consistency of the results shows that e.m.f.'s as small as 10^{-6} to 10^{-7} volts, induced by a magnetic field in moving mercury, can be accurately measured. This result also indicates the practicability of the method of investigating the flow of liquids proposed in the previous paper.

The Generation of Sound by the Siren Principle. By E. Simeon.

Abstract : The paper discusses various undesirable features of the simple siren, considered as a sound-source for technical work, and describes a siren with a reasonably pure note, the intensity of which can be kept constant throughout a range of pitch from about 70 to 7,500 cycles.

Surface Resistivity Measurements of Solid Dielectrics. By L. HARTSHORN, D.Sc., A.R.C.S., D.I.C.

Abstract : The paper describes (1) a new form of electrode suitable for surface resistivity measurements on insulating materials in sheet form, and (2) a method for the determination of the " volume leakage " correction for any system of electrodes. Data are given on the volume leakage correction for the various types of electrode in general use, and on the " leakage resistivities " of materials commonly used in the construction of laboratory instruments.

A Demonstration of the Regional Absorption of Dyes by Growing Crystals was given by Dr. A. G. MILLIGAN, of the Admiralty Research Laboratory.

Forthcoming Events, Etc.

ROYAL INSTITUTION.

21 Albemarle Street, W.1.

Friday, May 23, at 9 p.m.—" Some Scientific Instrument Makers of the 18th Century." By R. S. Whipple.

ROYAL MICROSCOPICAL SOCIETY.

20 Hanover Square, London, W.1.

A Special Meeting of the Society will be held in The Great Hall, King's College, Strand, London, W.C.2., on Wednesday, 21st May, 1930, from 3 to 10 p.m. Professor C. H. Desch, D.Sc., Ph.D., F.R.S., will preside.

3 p.m.—An Exhibition and Demonstration of the latest types of Metallurgical Instruments and Apparatus will be opened.

7 p.m.—Professor Nils E. Svedelius (Upsala) will deliver a communication on "The So-Called Freshwater Lithoderma."

7.45 p.m.—Scientific Communications and Discussion on Recent Advances in Current Research and Practice in Microscopic Metallography.

THE GERMAN BUNSEN SOCIETY.

The 35th general meeting of the German Bunsen Society (Deutsche Bunsen-Gesellschaft) for experimental physical chemistry, the leading German society in the physico-chemical sphere so highly important for science and technics, will be held at Heidelberg near the Rhine river from May 28th to June 1st, 1930.

Spectroscopy and Formation of Molecules will be the principal theme to come under discussion. Names of persons desirous to participate are received by the " Ortsausschuss der Deutschen Bunsen-Gesellschaft, Heidelberg, Ploeck 55 "—the local committee which will find accommodation.

Notices of Books.

An Introduction to Surface Chemistry. By E. K. RIDEAL. Second edition, enlarged. Pp. X + 459. Cambridge University Press. 1930. Price 21s. net.

The first edition of this work appeared in 1926. Considering the highly specialised nature of the subjects treated, the appearance of a second enlarged edition in four years shows that the author has made valuable contributions to the literature which are appreciated.

Chapter I deals with the surface tension of liquids. Speaking of surface phases it appears that when one distinct phase adjoins another conditions exist which distinguish the behaviour of a thin layer of matter at the boundary differing from that of the general mass of liquid in either of the homogeneous phases which bound it. The author proceeds to develop the subject, dealing with the total surface energy, capillary phenomena involving angle of contact, together with methods of measurement. Drops are treated and dynamic methods of analysis are discussed and explained. Surface energy and latent heat of evaporation are then considered and the influence of temperature where Eötvös' law is given at length. Following this the parachor of Sugden receives consideration. Capillary flow among other matters is treated in this chapter of 45 pages.

Chapter II deals with the surface tension of solutions, as with pure liquids the surface phase corresponds in composition with that of the bulk phase, while solutions do not so correspond. For example, the addition of a solute to a solvent will affect the surface tension of the latter. Since the energy of the system tends towards a minimum there will be a lowering of the surface tension of the solvent in which case the solute will, if this takes place, accumulate at the surface. On the other hand, if the solute elevates the surface tension of the solvent a reverse action takes place and the surface phase will be poorer in solute than the bulk phase. The enrichment or impoverishment of the

surface phase does not continue indefinitely, as a point is reached when the actions balance due to diffusion, the rate of which is proportional to the difference in osmotic pressures of the solute in the two phases. The mathematical treatment for determining the excess or deficit of solute in the superficial phase was first made by Gibbs. The author proceeds to develop this equation according to Gibbs and to Duhem. Experimental verification follows. The work of Langmuir enters into this development and the unimolecular Gibbs layer is studied. Negative adsorption is treated at some length, and following this the adsorption of gases and vapours on liquid surfaces receives ample investigation. The author concludes this chapter by citing the work of Harker and Neumann who observed the rate of hydrolysis of isoamyl acetate at a hydrochloric acid interface was identical with the rate obtained at the surface when a mixture of water and ester-vapour is passed over it, the rate evidently being limited by the attainment of surface saturation.

Chapter III deals with surface films of insoluble materials. Complex and colloidal films are among the phases of this treatment. Mention may be made of soap films, the permeability of buhbles and films.

Chapter IV deals with liquid-liquid interfaces. Here as before the subject divides into a number of parts. The heats of transformation of surface phases (5th). Rate of spreading (6th). Emulsions (11th). An interesting example is sketched on page 160. Emulsification produced by the addition of a dispersed solid to the two liquid phases is considered. A microscopic examination of water emulsified in benzine stabilised with lampblack indicated that the lampblack particles (6 shown in the diagram in section) surrounded an irregular, but approximately circular, section of water, the outlying or surrounding liquid being benzene. The ageing of emulsions is finally treated.

Chapter V deals with the gas-solid interface. The surface energy of a solid may be affected by the atomic or ionic configuration in the surface, the individual facets, edges, corners, and unstable agglomerates all possessing different values.

This part (4th) develops into a discussion of phase discontinuities. The Freundlich isotherm (5th) is considered here. Then comes the reflection and condensation of molecules on surfaces (6th). The Langmuir isotherm (7th) is treated. Surface mobility of adsorbed molecules comes next and on page 200 reference to L. de Broglie's papers on wave mechanics, the prediction of Elsasser of the wave nature of electron beams, the experiments of G. P. Thomson and those of Davisson and Germer, are cited wherein they bear upon the subjects of this treatise. Adsorption potential (9th) in which electrical forces enter is treated at considerable length. Heat of adsorption follows (11th). Rough surfaces, rate of surface attack, and catalytic reactions at solid surfaces complete this chapter. This is a little over half the book.

Chapter VI deals with the liquid-phase interface which is one of the most interesting chapters.

Chapter VII deals with differences of potential at interfaces. The galvanic cell is first considered in this respect. Electrocapillarity follows. Then passing over valuable matter electric endmose (9th) is treated at length. Electrification at gas-liquid interfaces (11th) is of particular interest and to which many pages are given.

Chapter VIII deals with conditions of stability in suspensions and emulsions. The Brownian movement comes first here. Electrolytic coagulation follows. Adsorption and entrainment of ions (8th). Valency rule of precipitation (10th). Ionic mobility and adsorbing power (11th). Effect of non-electrolytes on suspensions (13th). Precipitation by protective colloids (14th).

Chapter IX deals with gels and hydrated colloids. Gelatine and proteins (10th). Soaps (14th). Colloidal dyes (15th). Penetration in membranes (17th) closes the book except for name and subject indexes.

Many important features have not been even listed in this notice; but enough has been said to give the reader some idea of the scope of the work. Parts of the book are of course mathematical and on the whole it is an advanced treatment and pre-supposes considerable knowledge of the subject. This work is a valuable one and should appeal strongly to those interested in the structure of matter.

Regularities in the Arc Spectrum of Hafnium. By W. F. Meggers and B. F. Scribner. Sale: Sup. Dept. of Documents, Washington, D.C. U.S.A. Price 5 cents.

The first regularities among lines characterising the first spectrum of hafnium (Hf,) have been discovered. Combinations of seven low energy levels with higher excited states account for more than 200 lines. Inner quantum numbers have been assigned to the energy levels and a tentative identification of the seven low levels is suggested.

Our first attempt to classify Hf_I lines was not successful, but a wave number system containing 206 Hf_{II} lines was established without great difficulty. These first regularities in the spark spectrum of hafnium were published last year. Encouraged by the results obtained with Hf_{II} lines, attention was again turned to the Hf_I lines; a recurring difference of 1,071 cm^{-1} was found, but no further progress was made. It must be remembered that Zeeman effects, temperature classification, absorption data, and similar descriptive information which have aided in the analysis of other complex spectra were entirely lacking for Hf spectra and we had to depend solely on the combination principle as a criterion for classification. Very recently King has published the results of an investigation on the furnace spectrum of hafnum.

In our preliminary attempts to find regularities among Hf lines, we confined attention to differences less than 2,000 cm^{-1}, and thereby unwittingly shut ourselves off from the solution of our problem. When King's data on the furnace spectrum became available we made another attack on the structure of the spectrum by systematically subtracting from each other the vacuum wave numbers of all low-temperature lines (Classes II and III). This immediately led to the recognition of two important wave-number intervals, viz., 2,356.6 and 22,11.0 cm^{-1}. These then became the nucleus of a significant wave-number system which by successive addition of other levels finally became the 2-dimensional matrix given in Table 1. In this table the reative values for seven levels (A, B, C . . .) of low-energy content are printed at the top and the derived values for 63 higher states (1, 2, 3, 4, . . .) on the left margin. The level values are followed by a number (enclosed in brackets) which represents the value of the inner quantam number, which has been tentatively assigned to each level. Assuming that our level A has $j=2$, the relative values of the inner quantam numbers for other levels are derived from the observed combinations which appear in the body of the table, remembering that a combination is permitted only for changes of + 1 or 0 in the value of j. Owing to the relatively small number of low-energy levels which we have thus far established, it is not always possible to assign a final value of j to each of the high levels which we have thus far established, it is not always possible to assign a final value of j to each of the

The combinations of energy levels in Table 1 are represented by vacuum wave numbers of observed spectral lines. Above each wave number is the measured wave length, followed (in parentheses) by the estimated in tensity and the temperature class. When temperature class accompanies intensity the data are quoted from King; otherwise the intensities are taken from Meggers. In general, King's estimated intensities exceed those of Meggers in the ultra-violet, but are about the same for visible lines. There appears to be a discontinuity in King's temperature classes in the ultra-violet at 2,860 A. All lines of shorter wave-length are indicated as belonging to Classes IV or V, but our analyses show that many of these lines involve the low levels which otherwise predominantly give lines of Classes II or III. The tendency for temperature class to increase as the energy of the meta-stable levels increases is quite marked; it may be regarded as evidence that the levels are correctly oriented. It may be remarked that Table 1 includes a large majority of the stronger Hf_I lines; only one low-temperature line, 3,057.02 A (100 II) remains, and it is quite probable that it is a single combination of a level having $j=5$ with the low C level, $j=4$. The total number of lines classified in Table 1 is 218, four of which have been used twice. The average deviation of the observed wave numbers from the computed differences of the energy levels is only 0.05 cm^{-1}, which corresponds to an average error of less than 2 parts in 1,000,000 in the wave-length determinations of these lines. Somewhat better agreement between observed and calculated wave numbers of Hf_I lines as compared with the classified Hf_{II} lines is due to the fact that the centre of gravity of the former group is of greater wave length, for which the same error in wave length corresponds to a smaller error in wave number.

The Hf atom has 72 electrons ($Z=72$), but only 4 are concerned with the production of the first optical spectrum. The 4 valence electrons are normally in $5d$ and $6s$ orbits, either d^2s^2 or d^3s.

The total number of levels thus predicted is 47, nearly seven times as many as we have found. Comparisons with the analogous Ti_I and Zr_I spectra which have been very completely analyzed by Russell and by Kiess, respectively, shows, however, that only a small part of these theoretical levels are important in the production of the strongest lines. For purpose of comparison and dis-

ctra

The identification of the Hf_I levels is only tentative; it was suggested by comparison with the analogous Ti_I and Zr_I spectra. In each case a triplet F term is involved in the production of the strongest lines; in the Ti_I spectrum, $^3F_2$ represents the normal state (zero excitation energy) of the atom. In Zr_I a singlet-D term is (slightly) lower than $^3F_2$, and in Hf_I we may thus expect to find $^1D_2$ considerably lower than $^3F^2$. In our Hf_{II} paper, attention was called to a similar tendency of the doublet-D term in the analogous spark spectra, Ti_{II}, Zr_{II}, Hf_{II}. Although a lower singlet-D term in the Hf_I spectrum has been sought, it has thus far evaded us.

In Ti_I the intervals between the sublevels of ^3F are $^3F_3-^3F_2=170$, $^3F_4-^3F_3=217$, which are exactly in the ratio of 3 to 4, in agreement with Landé's interval rule. This interval rule is not strictly fulfilled in Zr_I, where the intervals in question are 570 and 670, and the deviation becomes still greater in Hf_I, with intervals 2,356.6 and 2,211.0. If, however, the sums of the intervals or range of ^3F in the three spectra are compared, we find $Zr/Ti=3.2$ and $Hf/Zr=3.6$, which leads us to believe that our interpretation of the first three levels (A.B.C. . . .) in the Hf_I spectrum may be correct.

In general, low or metastable ^3P terms in complex spectra follow the interval rule fairly closely. Thus in Ti_I the ratio $^3P_1-^3P_0/^3P_2-^3P_1$ is almost exactly 1 :2. Zr_I appears to offer an exception, but we are nevertheless inclined to interpret our levels D, F, G in the Hf_I spectrum as ^3P, since the inner quantam numbers appear to be 0, 1, 2, and the intervals are in the ratio 1 :2.1.

The remaining level, E, may be interpreted as a singlet-D level, although probably not the lowest one of this type. A quintet-F term provides some important metastable levels in both the Ti_I and Zr_I spectra, but we have been unable thus far to find the homologous term in the Hf_I spectrum. In the absence of Zeeman effects, no attempt is made to name any of the higher terms of the Hf_I spectrum. The authors plan to investigate the magnetic resolution of the Hf lines, but on account of the abnormal magnetic splitting factors (g) which may be expected we are not optimistic about the value of such observations except for identifying the low-energy levels.

The above is taken from the reprint, the tables and references to other work being omitted, but only slightly abbreviated otherwise.

Die Globuline. By Dr. Mona Spiegel-Adolf. Pp. 458. Dresden and Leipzig: Theodor Steinkopff. 1930. Price 83 marks.

The globulins are a group of protein bodies, distinct from the albumins, with which, however, they are often associated, *e.g.*, in blood serum. They are exemplified by serum globulin, myosinogen, fibrinogen and by such derivatives of these as myosin and fibrin. The globulins are not confined to the animal kingdom. The seeds of many leguminous plants, and others, are rich in these complex proteins and even afford suitable sources for their preparation. Typical globulins are irreversibly coagulated by heat and are insoluble in water. Dilute saline solutions will dissolve them but they remain insoluble in strong salt solutions and they may be precipitated by means of magnesium or ammonium sulphate.

The importance and significance of these substances, both as reserve foods and as essential components of organic tissues has recently been recognised in biochemistry and biology and it is noteworthy that Dr. Mona Spiegel-Adolf, who is assistant in Dr. Wolfgang Pauli's Institute for medical applications of colloid chemistry in Vienna, has filled over 400 pages with her monograph on a description of the occurrenee, extraction, characteristics and behaviour of the globulins. Considerable attention has been given to the chemical properties of these substances, as individuals and as a group of proteins and their importance in medicine and biology has been stressed.

Second Report of the Fabrics Co-ordinating Research Committee. Pp. viii + 180. H.M. Stationery Office, Adastral House, Kingsway, W.C. 1930. Price 5s.

The terms of reference of the Governmental Fabrics Co-ordinating Research Committee provide for an interchange of information between the various Government Technical Establishments concerning the special researches on fabrics. Such information is also usually available to interested bodies outside the Government service. The present report deals with such matters as the fireproofing of fabrics, the action of sunlight on cotton, fastness of dyes, and matters relating to the co-ordination of information. Much useful information has been impressed into a number of Appendixes which actually occupy the bulk of the volume.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

11,183.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of vat dyestuffs of the anthraquinone series. April 8.

11,343.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of vat dyestuffs of the anthraquinone series. April 9.

11,182.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of sulphuryl chloride. April 8.

11,279.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of valuable hydrocarbons. April 9.

12,681.—Bloxham, A. G. (Soc. of Chemical Industry in Basle).—Manufacture of anthraquinone derivatives. April 24.

12,812.—Bloxam, A. G. (Soc. of Chemical Industry in Basle).—Manufacture of anthraquinone derivatives. April 25.

12,703.—Bohme Akt.-Ges., H. T.—Preparation of sulphonic acids of the aliphatic series. April 24.

12,721.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of iodo methane sulphonic acid &c. April 24.

12,522.—Gutehoffnungshutte Oberhausen Akt.-Ges.—Prodnction of formaldehyde from methane and carbon dioxide. April 23.

Specifications Published.

327,443.—Tate, W. R., Stephenson, H. P., and Imperial Chemical Industries Ltd.—Method of destructive hydrogenation.

327,428.—I. G. Farbenindustrie Akt.-Ges. Manufacture of solutions of the conchona alkaloids.

327,450.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of notro halogen quinazolines.

328,029.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of liquid nitrogen dioxide.

328,032.—I. G. Farbenindustrie Akt.-Ges. —Process for the manufacture of hydroxy sulphonic acids and salts thereof.

328,156.—I. G. Farbenindustrie Akt.-Ges. —Purification of highly concentrated nitric acid.

Abstract Published.

326,137.—Organic phosphorous compounds. —(I. G. Farbenindustrie Akt. Ges.; Frankfort-on-Main, Germany.).

Organic phosphorous compounds are prepared by condensing a triarylphosphine oxide with a compound containing a phenolic hydroxy group. The products are used pharmaceutically, and for protecting materials against micro-organisms and insects such as moth caterpillars. Examples are given of the interaction of triphenylphosphine oxide with 4-benzylphenol and of *o*-tritolylphosphine oxide (obtained by condensing *o*-chlorotoluene with phosphorous trichloride in the presence of sodium and oxidizing the resulting phosphine with chlorine water) with phenol. Reference is also made to the condensation products of triphenylphosphine oxide with phenol, *o*-, *m*-, and *p*-cresol, *o*- and *p*-chlorophenol, thymol, 1-methyl-3-hydroxy-4-isopropyl- 6 -chlorobenzene, 2 :6-dichlorophenol, 2 :4 :6-trichlorophenol, *sym*-xylenol, 6-chloro-2-cresol, 6-chloro-3-cresol, 3-chloro-4-cresol, *p*-hydroxybenzoic acid ethyl ester, *p*-nitrophenol, pyrocatechin monoethyl ether, resorcinol, *p*-hydroxybenzaldehyde, α- and β-napthol, *m*-hydroxydiethylaniline, *ar*-tetrahhydro-β-napththol, 4-*n*-butylphenol, 2 :4-dichlorophenol, 2-isobutyl-4-chlorophenol, 1-methyl-3-hydroxy-6-isopropylbenzene and 1-hydroxyphenyl-3 :4-dicarbaxylic acid dibutyl ester. The Provisional Specification states that any phosphine oxide may be employed.

1-Hydroxyphenol-3 : 4-dicarboxylic acid dibutyl ester is obtained by heating 1-hydroxy-3 :4-pthalic acid with *n*-butyl alcohol.

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NOTICE TO AUTHORS & CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News.*

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No notice can be taken of anonymous letters.

RAMAN EFFECT AND TWO KINDS OF HYDROGEN: BEING A LECTURE BY SIR E. RUTHERFORD.*

All of you are familiar with the scattering of light by small particles and the 'Tyndall blue' of the scattered light, when white light from the carbon arc or the sun falls on a solution filled with a multitude of small particles. The late Lord Rayleigh in 1871 first gave the mathematical theory of the scattering of light by such particles, and was able to account in a general way not only for the colour of the reflected light but also for its state of polarization. He suggested that light should be scattered, not only by particles containing many millions of molecules, but also by the individual molecules themselves, and that the blue of the sky was probably due mainly to the scattering of sunlight by the molecules of the atmosphere in its path.

This suggestion of molecular scattering was strikingly confirmed by the experiments of his son, the present Lord Rayleigh, who showed that scattering of light could be observed in gases freed from all dust nuclei, and that the light scattered perpendicularly to the direction of the incident beam was mainly plane-polarized.

In recent years there has been a large number of investigations on the scattering of light, not only by gases but by liquids and solids, with special attention to the amount of scattered light and the degree of its polarisation. I shall not refer here to these results and the interesting deductions that have been made from them, but concentrate attention on a more recent development. Sir Venkata Raman, of the University of Calcutta, who had for many years experimented on this subject, made an important observation which has thrown much new light on this question. For simplicity, suppose that monochromatic light of a definite frequency passes through an organic liquid, say, benzene or toluene, which has been carefully purified. It was observed that the colour of the scattered light was distinctly different from the incident beam, showing that the light had in some way been altered by scattering by the molecules in the liquid. To examine this change more accurately, the scattered light was passed through a spectroscope. A striking result was observed. The strongest line was equal in frequency to the incident light, as was to

* Part of the Anniversary Address delivered before the Royal Society — *Proceedings*, page 184 onwards (vol. 126 A).

be expected on the classical theory, but in addition a number of new lines was observed on the low-frequency side of the main line, and a few fainter ones on the high-frequency side. By the process of *scattering*, a set of new discrete frequencies had thus made their appearance.

An excellent account of these beautiful experiments was given this year by Raman and Krishman in our *Proceedings*. Similar effects were observed by Landsberg and Mandelstamm by examining the light scattered by certain crystals. Such experiments are not easy, for the scattered light is very feeble, and long exposures with intense source of light are necessary to bring out the relatively faint new lines. An examination of the results showed that the changes of frequency depend on characteristic frequencies of the molecule, connected with its vibrational states.

The interpretation of these results is most clearly seen by consideration of the similar effects in gases, and we shall consider these first. For example, if ν be the frequency of the incident light, the frequencies of the new lines are $\nu-\nu_1$, or $\nu+\nu_r$, where ν_1 is always found to be a difference between two fundamental frequencies of the molecule. This is completely in accord with the quantum theory of scattering which was given formally by Kramers and Heisenberg in 1925. It is to be presumed that the light scattered by liquids is of the same nature, and the frequency shifts are due equally to differences of molecular frequencies; although in molecules, which absorb strongly in the infra-red, these differences may themselves appear as actual molecular frequencies.

It is of interest to note that the possibility of a process of this kind, involving the appearance of new frequencies, had been predicted by Smekel as well as by Kramers and Heisenberg. While theory and experiment agree admirably for gases, the theory could not have been legitimately extended to the case of molecules of a liquid, and here the Raman effect provides a new and effective tool for determining frequencies which are naturally present in a liquid or a solid.

It is clear that this new effect may be of great importance in determining the slow characteristic frequencies of molecules in the infra-red, which may be difficult to measure by other methods. This new discovery, of great interest in itself, thus promises to open up a new field of experimental enquiry, and throw valuable light on the modes of vibration and constitution of the chemical molecule. This discovery has attracted much attention, and a number of papers dealing with it has been published in all parts of the scientific world.

It is naturally of great interest to consider the processes occurring in the molecule that give rise to these scattered radiations. The action of a train of waves in its passage through the complex electrical system of a molecule, which may be set in vibration in a variety of ways, is naturally very complicated and difficult to explain briefly in simple language. If, however, we content ourselves with a consideration of the energy changes only in the radiation, and disregard the detailed mechanism involved in the radiation process, a simple explanation can be offered on the ideas of the light quantum.

We start by observing that it is a general consequence of wave mechanics that if a system possesses a number of states of equal energy, there is usually a finite probability of a transition from one of the number to any of the others. Consider a quantum of light, of frequency ν and energy $h\nu$, falling on a molecule in a given direction. The quantum and the molecule are to be regarded as a single system. This system has a number of other states of the same energy. Firstly, those in which the molecule is unchanged and the original quantum is scattered in a new direction without change of frequency; transitions to these states correspond to Rayleigh scattering. Secondly, other states in which the state of the molecule is changed, its energy being altered by $\pm h\nu_1$, while a quantum of light of energy $h\nu \pm h\nu_1$ is scattered in some new direction. Changes of these states correspond to the Raman effect, where frequencies $\nu-\nu_1$ and $\nu+\nu_r$ are observed. The actual changes occurring in the molecule to give rise to these new frequencies can only be inferred from a detailed consideration of the possible modes of vibration of the molecule itself.

I shall not consider a very interesting discovery which has been made in the last year. It has been found that, in a sense, hydrogen consists of two different kinds of molecules, which under ordinary conditions of temperature and pressure behave in a distinctive way. For example, the specific heat and conductivity of the two kinds of hydrogen are very different. I will first state the general conclusions to be drawn from the experimental observations and later discuss the intimate connection of the theory with experiment that led to this discovery.

The hydrogen molecule in the normal state consists of two nuclei and two electrons. On the ordinary views of the gas-kinetic theory it is to be expected that the molecules, in addition to their ordinary velocity of agitation, may rotate on an axis perpendicular to the line joining the nuclei. On the quantum theory it has a series of states of rotation which are specified in terms of a quantum number which has the values 0, 1, 2, 3, etc. Experiments on the band spectrum indicate that in ordinary hydrogen gas at atmospheric temperature, the molecules which have rotation numbers 1, 3, 5, are about three times as numerous as those with even rotation numbers 0, 2, 4 . . . For convenience, the molecules of even rotation number will be termed α-hydrogen, and those with odd rotation numbers β-hydrogen. When in equilibrium the relative number of hygrogen molecules in the different rotation states at any temperature is governed by the well-known Boltzmann law of distribution and can be calculated approximately. If, however, ordinary hydrogen gas is reduced to a low temperature, say, that of liquid hydrogen, on the ordinary kinetic theory it is to be expected that the rotation of the molecules should practically vanish, *i.e.*, the majority of the molecules should have a rotation number 0 and only a small fraction, depending on the temperature, remains in the higher rotational states.

Actually, however, it is found that while α-hydrogen is mainly in the rotation state 0, the β-hydrogen does not change into the state 0, at any rate for a long time, but retains its individuality, although, of course, the ratio of the number of molecules in each odd rotation state is governed by the Boltzmann law. The surprising fact emerges that the β-hydrogen under the influence of ordinary gas-kinetic collisions is only with great difficulty changed into α-hydrogen. The time required for true equilibrium, after lowering the temperature, may be measured in months, or even in years under some conditions. This interval depends, as we should expect, on the pressure and temperature of the gas, since these govern the number and magnitude of the molecular collisions. This means that a molecule with odd rotation number finds a very great difficulty in passing to the even state of rotation.

A general explanation of this can be given on wave mechanics and it appears to be intimately connected with the weak coupling between a rotation state of the molecule with the spin of the minute indivdual nuclei (protons) which make up the molecule.

While under normal conditions the passage of β-hydrogen into α-hydrogen and *vice versa* is exceedingly slow compared with the duration of an ordinary experiment, yet the transitions can be greatly accelerated by appropriate treatment of the gas. For example, if hydrogen cooled to a low temperature is subjected to an electric discharge, there is a rapid transformation.

The passage of the cooled gas through charcoal immersed in liquid air or liquid hydrogen acts in a similar way. When the hydrogen is rapidly cooled to the temperature of liquid air, the odd rotation states are much in excess over the equilibrium value. The passage through the charcoal causes a rapid transformation of the β-hydrogen and the emerging gas, at the temperature of liquid air, consists mainly of α-hydrogen.

It is of great interest to note that if the gas is warmed to ordinary temperature after passage through the charcoal, it remains mainly α-hydrogen, while hydrogen gas in equilibrium consists only of about one-quarter of α-hydrogen. It has been found that the specific heat of the gas and its heat conductivity at a temperature of liquid air before passage through the charcoal are markedly different from the values for the gas at the same temperature issuing from the charcoal. In a sense we may say that α-hydrogen has been obtained by this process in an approximately pure state. The effect in charcoal cooled to the temperature of liquid helium would be even more complete.

It seems probable that the rapid transformation brought about by passage through charcoal is catalytic in nature, and may quite likely be due to the dissociation of the molecules into atoms aud their subsequent recombination to form new molecules. This striking and unexplored behaviour of hydrogen—the simplest molecule known to us—is of great theoretical as well as experimental interest.

I shall now attempt to describe briefly the various observations and theoretical suggestions which have ultimately led to the experimental proof of the existence of these two kinds of hydrogen molecules. It has been known for some time that no satisfactory theoretical explanation could be given of the change of specific heat of hydrogen with temperature, either on the kinetic theory or with the modifications of the theory based on the older form of the quantum theory.

A new orientation of our ideas was given by the development of the wave-mechanical theory. One of the first triumphs of this theory was the explanation by Heisenberg of the complex spectrum of helium. The two types of spectra which appeared were shown to be connected with the different directions of spin of the electrons themselves. In one case, the orbital wave functions were symmetrical and in the other case antisymmetrical. From analogy with the behaviour of the helium atom, Hund showed that it was to be expected that the hydrogen molecules should consist of two kinds; in one, which we have called α-hydrogen, the wave functions were symmetrical in the rotational wave function and in the other called β-hydrogen antisymmetrical. It was recognised that on the wave theory, there must be a very weak coupling between the symmetrical and antisymmetrical states, so that the transition from one state to the other must be fairly slow.

Dennison, in a paper published in our *Proceedings* in 1927, calculated the specific heat of hydrogen at different temperatures on the bold assumption that the time of transition from one state to the other was very slow—of the order of one year—compared with the time required for a determination of the specific heat experimentally. Under these conditions, ordinary hydrogen could be considered to be a mixture of two gases, which have not only different specific heats but a different variation with temperature.

By assuming the ratio α- to β-hydrogen was 1 to 3, he found that the calculated and observed specific heats agreed over the whole range of temperature. The ratio between the two states of hydrogen was in accord with the observations of T. Hori on the band spectrum of hydrogen.

Experimental proof of the accuracy of this deduction was soon forthcoming by a variety of experimental methods. Prof. J. C. McLennan examined the Raman effect in liquid hydrogen and found that the changes of frequency observed in the spectrum of the scattered light indicated that hydrogen at this temperature consisted of a mixture of molecules having even and odd-rotational states. The relative intensity of the lines was in accord with the relative distribution assumed by Dennison.

About the same time experiments were undertaken by Eucken and Hiller and by and Hiller determined the specific heat o hydrogen under different conditions. Hydro gen at high pressure was kept for some day at the temperature of liquid air, the specifi heat was measured at intervals and at dif ferent temperatures, and was found to show marked variations with time. The fractio of α-hydrogen was found to vary from 2 per cent. at the beginning to 95 per cent after a long interval. It was found that th rate of transition from β- to α-hydrogen a liquid air temperature depended on th pressure of the gas and was approximatel proportional to the number of molecula collisions.

Bonhöffer and Harteck used a simple and more rapid method for following th change of state of the hydrogen under di ferent conditions. By measuring th change of resistance of a heated wire i the presence of the gas, the changes in hea conductivity of the gas, which varies wit the specific heat, were easily followed.

We have already referred to their exper ments of passing hydrogen through charco at low temperature and of the effect of th electric discharge. The results of th beautiful experiments of Bonhöffer an Eucken afford a complete and striking proo that hydrogen under ordinary conditions composed of two sets of molecules whic are transformed into each other so slowl that they may be regarded in a sense as tw distinct gases differing in specific heat an conductivity. The specific heat of α-hydro gen at low temperature is greater than tha of β-hydrogen. A large quantity of heat given out in the passage of β- into α-hydro gen. At very low temperatures, the hea evolved in this transformation is greate than the heat of volatilisation of liqui hydrogen.

It may be of interest to note that the be haviour of hydrogen might have been di covered long ago, for no new experiment knowledge or technique is involved. Atten tion, however, was only directed to this sul ject by the failure of existing theories t account for the variation of the specifi heat of hydrogen with temperature. Th development of wave-mechanics threw ne light on this problem and a happy sugge tion, based on this theory, was found to f in well with the observations on the specifi heat. Following this clue, the question wa attacked experimentally by several differer methods, with results in complete accor

TRANS-NEPTUNIAN PLANET.

Note by M. Benjamin Jekhowsky,

(Présentée par M. Ernest Esclangon) in *Comptes Rendus*, 1930, *190*, 1049-1050.

Le calcul de l'orbite de la planète Lowell a donné lieu à de norbreux résultats plus ou moins concordants. On doit admettre que ces divergences dépendent aussi bien des méthodes employées pour le calcul que du choix des observations.

Des premières observations, mars 16 (Yerkes) et 26 (Paris), en tenant compte de la parallaxe et de l'abberation, j'ai déduit par la méthode Lagrange-Andoyer (B. Jekhowsky, *Journal des Observateurs*, 1926, *9*, No. 10, 137), pour l'époque moyenne de 1930 Mars 21. 2722 T. U. l'orbite circulaire suivante :

(I)

$u_0 = 359° 14'.8$; $\Omega = 109° 42'.8$; $i = 14° 2'.0$;
$a = 35.727$; $\mu = 16''.615$;

ces éléments sont rapportés à l'équinoxe et à l'écliptique du commencement de l'année d'observation.

Le nombre d'observations étant devenu plus grand, je me suis proposé de déduire une orbite elliptique, en me basant sur les deux observations ci-dessus et celle d'avril 3 (Bergedorf). J'ai été conduit, par la méthode Lagrange-Andoyer (H. Andoyer, *Cours de Mécanique céleste*, *1*, p. 141 et suiv), particulièrement indiquée pour ce calcul, aux valeurs suivantes des ρ_1, ρ, ρ_2, r_1, r, r_2, distances géocentriques et héliocentriques de la planète,

(II)

$\rho_1 = 40.285$; $\rho = 43.887$; $\rho_2 = 46.570$
$r_1 = 40.815$; $r = 44.108$; $r_2 = 47.738$

en constatant que le calcul de l'excentricité de l'orbite est pour le moment inaccessible.

En reprenant le calcul avec des observations plus espacées, notamment avec celles des : Mars 16 (Yerkes), Avril 3 et 17 (Paris), j'ai obtenu

(III)

$\rho_1 = 42.060$; $\rho = 41.358$; $\rho_2 = 40.847$;
$r_1 = 42.354$; $r = 41.439$; $r_2 = 40.691$;

d'où l'on déduit les dates moyennes, comme distances de l'astre au Soleil :

(IV)

Mars 25.720 ... ... $r = 44.219$
Avril 2.053 ... ... $r = 41.495$

valuers assez concordantes avec celles obtenues par M. Esclangon (*Comptes rendus*, 1930, *190*, 884, 898 et 958).

Mais on ne pourrait en conclure que la distance r est ainsi bien et définitivement déterminée. Un examen attentif des nombres que l'on obtient au cours d'un calcul de ce genre montre qu'en élargissant les intervalles, que séparent les observations, la valeur de la distance r diminuera encore et les calculs laissent prévoir que l'orbite de cette planète s'approchera de celle que j'ai calculée en premier lieu (I).

Ces éléments représentent assez bien les observations. Ils ressemblent aux éléments donnés par M. Banachiewicz (*Acta astronomica*, 1930, série C, *1*, 99-100; *Okolnik Observatoryum Krakowskiego*, 1925, No. *17*, 1 et suiv.), obtenus à l'aide des cracoviens.

We should like to change the wording on page 313, referring to the same subject—the trans-Neptunian planet. " with the 28-inch reflector of the Heidelberg Telescope " should read : with the 28-inch reflector at the Heidelberg Observatory. There are one or two other details that might be improved but those familiar with the subject will no doubt follow the present rendering.

IMPORTANCE OF CANADIAN BERYL DEPOSITS NOT YET ESTABLISHED.

As a result of the publicity recently given to the occurrence in Canada of beryl, the only recognised ore of beryllium, nnmerous enquiries have reached the Mines Branch of the Dominion Department of Mines concerning the possibility of securing supplies from Canada. It has accordingly been deemed desirable to issue a brief summary on the situation. The information bere given is abstracted from a Memorandum Series Circular " Notes on Beryllium and Beryl " to be issued sbortly by the Mines Branch.

Many of the recorded occurrences of beryl in Canada have been found as a result of mining operations for mica or feldspar, beryl being a not infrequent mineral in certain of the pegmatite dykes that have been worked for tbese products in Ontario and Quebec, and also in British Columbia. In another instance beryl has been found in a pegmatite explored for molybdenite. In none of such workings, however, is beryl known to have been found in anything approaching commercial quantity, the occurrences being regarded as of mineralogical interest only.

A single deposit of possible economic interest is known in Ontario, and was worked on a small scale in 1926, with the production of a few tons of small green beryl crystals, which were shipped to Germany. The beryllium oxide content of this beryl was 14.38 per cent. The mineral occurs as small crystals, averaging about 3 inches across, scattered rather thickly through a narrow ten-foot pegmatite dyke, which is

exposed for about 150 feet. Some of the larger crystals yield small clear fragments approaching gem quality (acquamarine), but most of the material is cloudy, stained and flawed. The narrowness of the dyke renders questionable its ability to furnish any considerable tonnage of beryl, but further exploration in depth is required to determine the economic possibilities.

The discovery of beryl in Southeastern Manitoba, in the Winnipeg River—Bird River region which district has latterly been actively prospected for lithium minerals and tin, has received a good deal of publicity. There is an extensive development of pegmatite dykes in the region.

THE INFLUENCE OF TECHNIQUE ON RESEARCH : BEING THE TWENTIETH MAY LECTURE TO THE INSTITUTE OF METALS, DELIVERED MAY 7, 1930.

By Major F. A. Freeth, O.B.E., D.Sc., Ph.D., F.R.S.

If an address of this character is to achieve any useful purpose it must embody constructive suggestions. None of the suggestions now to be put forward is really novel, but the time and the place are propitious.

We all know the names of those men who are " landmarks " in the history of science. They occur infrequently, and the great bulk of us must accept our natural mediocrity. Therefore, whilst it is probably not possible to prescribe and to legislate for the greatest types of discovering mind, yet it is possible, especially in the light of history, to lay down a number of maxims which, whether appreciated or not, have been a means of stimulating discovery in the past and will certainly serve again in like manner in the future. One of the most obvious and inportant of these is a proper control of the variables of nature and the possibility of manipulating matter and subjecting it to treatment under the most varied conditions. This is what I mean by technique. It is very difficult to imagine what would be the present state of science and, incidentally, of industry if rubber, mercury, and glass were unheard-of substances. Platinum also has played a big part in the development of discovery. Consider the matter from an entirely different point of view ; suppose that there were made a statistical analysis of the variables under which every chemical and physical experiment has been made during the last hundred years. It would be found that there was an overwhelming majority of these experiments made within those conditions, say, of temperature and pressure which are very easily attained—namely. those which are near to the ordinary conditions of our human existence. Someone might turn round and say that surely these are the most important. The reply would be that such a criticism could never be made here because it is manifest that the future progress, prosperity, and advancement of the Institute of Metals will depend very largely on further conquest of those very difficult variables of nature under which you already work—that is to say, upon improved technique.

Let us consider for a moment one or two of the great schools of discovery which, in addition to the genius of their founders, have owed a great deal of their success to difficult methods of manipulation. The classic instance is, of course, that of the discovery of the rare gases of the atmosphere by the late Sir William Ramsay. That discovery, originated from discrepancies in a physical constant of nitrogen prepared chemically from nitrogen derived from the atmostphere. But it was Ramsay's extraordinary powers of manipulation, the originality of his technique, which clinched discovery and made success possible. Take, again, the famous low-temperature school of my old and lamented friend the late Professor Kamerlingh Onnes, of the University of Leiden. In that wonderful laboratory he had to build up a school of technique about which I shall have much to say later in the course of my lecture. Let us consider some of the discoveries that he made—supraconductivity, for instance. The change, as you know, is a remarkable one ; at a certain temperature resistance practically vanishes. Why was not this discovered much sooner? The answer is because of the enormous physical experimental difficulty in attaining a sufficiently low temperature. Like all other technical difficulties once they are overcome, time and experience make easy the repetition of the work. Liquid helium, once almost as rare as the great auk, is now manipulated by the litre.

Coming to recent times we have Kapitza's wonderful experiments in a high magnetic field—again largely a matter of technique—which when carried out at low temperatures will undoubtedly give results of the greatest theoretical importance. Then we have the wireless valve, the uses of which are so extraordinarily varied : that has been evolved from a vacuum technique. All the above are examples of technique which has proved of the greatest value to research. Methods of working which are so new that

sufficient time has not elapsed to enable them to be generally appreciated may be mentioned—*e.g.* the remarkable work published about a year ago by Burch on distillation in a really high vacuum (which, in my opinion, may have a profound influence on organic chemistry and on biochemistry), and the work which is being carried out by Michels in Amsterdam at what popularly may be referred to as super- or possibly hyper-pressures.

Turning to industry for a moment, you all know the remarkable results achieved by the chemical technologist during the past decade by his new pressure technique. I have long been convinced that the study of metals is as yet almost in its infancy, and that in spite of the voluminous and magnificent work which has been hitherto accomplished. Metallurgical progress will depend upon the way in which you can manipulate the very difficult conditions which are inseperable from your work.

It is when we come to examine the technique of research, its lacunæ and variabilities, that the situation in this country becomes so disquieting. I propose now to point out the weaknesses and defects which are hampering research in this country, and to show how, for their remedy, they require mostly time and determination and only quite an inconsiderable amount of money.

Before we begin, however, we must demolish at least one bogey. This is what, for want of better terms, might be stigmatized as the "stick-and-string" school. There is much to be said for the stick-and-string school. Their outlook is this : that an enormous amount of work of the greatest value and importance has been done during the last hundred years by experimenters whose resources have been of the most meagre character. They are really the idealists who are paying a tribute to genius, and it is very difficult to criticize them with any sense of proportion, because in some respects they are so perfectly right. This person at his worst says : "Give the young man a few lengths of glass tubing a little sealing-wax, and a large ball of string and, given the necessary genius, here is a second Faraday." With great respect I venture to think that the man who puts forward this sort of proposition is stronger in his heart than in his head. It is perfectly true that in science, as in everything else, we have the jackdaw type of mind. . . Technique travels almost exclusively by example and by word of mouth. The reasons for this are twofold. If you are sufficiently fortunate to travel considerably you will in time be able to recognise where you are by the apparatus you see about you. That is to say : If you were blindfolded, and taken to any laboratory in Western Europe and then allowed to look around you, you would be able to guess not exactly where you were, but you would be able to say,in all probability, that the people there were a part of the "——" school of research.

Now, why does technique travel so slowly There are numerous reasons, some of which are what the writers call very "human." You remember the words of Bacon when he says : "It is a strange thing to behold what gross errors and extreme absurdities many (especially of the greater sort) do commit, for want of a friend to tell them of them." Also we can learn something from Stevenson's lawyer, Mr. Utterson, who was a man of "no scientific passions (except in the matter of conveyancing)." In discussing technique we are dealing with a subject in which many of the commonest human emotions come into play—and we all have them. We all know, and some of us smile tolerantly at, our friend whose car is one of the finest in Great Briain irrespective of its make and age. It is emotions of this character which hinder the progress of science to a great extent. Suppose that you, as is most probable, are a tactful and charming individual, and during the course of a visit to your friend the Professor of Chemistry at the University of Pekin you tell him that the methods of regulating high temperatures at the University of Timbuctoo which you have just left are worthy of consideration and imitation. In ninety-nine cases out of a hundred you will find a considerable resistance on the part of your friend. Similarly, suggestions of altering one's own experimental methods cause an instant instinctive opposi tion. I am convinced that the above state ment is generally true, and by recognizing it we have gone three-quarters of the way towards removing the difficulty. Now, why do people usually resist new experimental methods? There are, I think, a number of reasons. In a very great number of cases you will find that a particular school of research has been built up on a technique devised by itself, and perfected after a long series of disappointments and difficulties. If it depends upon the particular skill of an individual so much the worse. So many of us are quite oblivious to our really strong points and inordinately proud of one of our

second-rate accomplishments ; thus when a new technique comes along there is pride in the old one and very often a real difficulty in taking up the new one. It is, for example as you all know, almost impossible to learn some things by merely reading of them, just as you, and I am sure I, would obiect to be operated upon by a book-trained surgeon. Personally, I am convinced that the difficulties to which I have halfplayfully alluded would be nothing like so great as they are if all laboratories of any standing possessed reasonable mechanical facilities for carrying out experimental work. It is one thing to be shown or told of something new that you cannot carry out, and a totally different state of affairs if you are able to put it instantly into execution.

Surely one of the weakest spots in research in Great Britain today is the totally dispro portionate strength on the side of technique as against the numbers and efforts of the people who are engaged in research. This is hardly a matter of opinion ; it is stark fact. I have discussed this matter with every scientist I have met, and all schools of thought have been in cordial agreement.

Generally speaking, is it too much to say that the experimental facilities of the average University or research institution in this country, industrial or not, are not nearly so effective as they could easily be. Why is this? The reasons are twofold—lack of realisation on the part of people with the power to remedy it, and a certain apathy on the part of a few of those who would benefit by it.

Let me give you an example of a great need which formerly existed in a particular branch of research and has now been met to a large extent. I am referring to physical chemistry in particular, the need being the lack of apparatus for research. Universities and many research institutions in this country are frequently the result of private benefactions, and it would be an extremely interesting study if one could look into the minds of the generous donors and examine in detail their motives and feelings. Whilst you can generally reckon on finding a rich benefactor who will endow a chair or build a laboratory or even a university, you will generally observe that his research laboratory or institution is possessed of very little money to carry on with, and that in many cases there is no money available for the conduct of research.

The general complaint of bodies such as the Royal Society is that their funds are ear-marked and that they have no money available for general purposes. The case we have just considered is a similar one, and was met by a gift of money ear-marked for what amounts to a general purpose—namely, the purchase of apparatus and chemicals only. Thanks to the wisdom and generosity of my own company, research in physical and certain other branches of chemistry is now adequately supplied with apparatus . . . .

I have already mentioned that, in my opinion, the general mechanical facilities for research in this country are very poor. Let us begin with a most important factor, mechanics and glass-blowers. Generally speaking, they are not good enough and even if they were, they are not sufficiently plentiful. Of course, as we all know, there are some magnificent British fine mechanic and glass-blowers, and what so frequently makes them all the more worthy of respec is the fact that they have fequently arrive at their present excellence *ab initio* as i were. The fault, or rather the difficulty with our own mechanics and glass-blower is that they very seldom have a chance c handing on their skill and experience to any one else in a systematic manner. A scientis who has not access to a good workshop doe not know what he has missed, his exper mental and even his metal work is handi capped by the constant succession of inhib tions due to his lack of mechanical aid The number of skilled assistants in th country of this character could be qua rupled with enormous immediate advanta to science, and subsequently to industry.

Modern biology and physiology, f example, would benefit enormously by mo mechanical assistance.

You may ask me why is there not a outcry, a loud demand, for what I say is crying necessity. In parenthesis I will s categorically that there is not a universit or research institution, in Great Brita where existing facilities could not doubled with advantage, and there a plenty with no facilities at all. Why, the is there no loud insistent demand? T reason, I think, is threefold : (1) The m are not to be had ; (2) there is no money pay them ; and (3) I think that the avera research worker in this respect has co down to a settled despair.

Now what can be done, and what is t state of affairs in more fortunately situat countries? Let me take the case of c country with which I am really familia Holland. Throughout the whole of t country, in universities, technical scho

and in industry, there is an extraordinarily high standard of experimental skill available for the research worker. That has not always been so, and the present situation is no accident. It is due to the genius and foresight of the late Progessor Kamerlingh Onnes. About forty-five years ago he planned an attack on the physics of low temperatures which occupied him till his death, and which is still going forward. Professor Onnes realized at the outset that an experimental technique aud a standard of skill hitherto unheard of would be required and also that he would require far larger numbers of men than could be obtained casually. He therefore started the uow famous "Society for the Education of the Instrument Maker," which is a remarkable institution. It consists of a large number of people, many of whom people like ourselves would describe in army language as "civilians," who subscribe towards the fund of the Instrument Makers' School at Leiden. The course at that school lasts about five years, and the institution is not quite self-supporting. Only those who, like myself, have had the pleasure of working with its finished products can realize their extraordinary efficiency and originality. You will see that I am shying at the word "training." Many people are obsessed by the idea that you can train nearly anybody for anything. Really effected people are not trained at all, they are allowed to develop their natural aptitude by sitting at the feet of a master. There is all the difference in the world in this distinction. Now that research in this country offers the possibility of a career, which of course it should, we have the occupational trainee with us in ever-increasing numbers. Now I can easily imagine someone saying, "Can you imagine any body of people in Great Britain subscribing money to an object such as the Leiden Institution and having no direct connection with science or industry?" Admittedly it is not likely, but it is by no means impossible. There is in Bristol a society, whose labours do not receive anything like the credit they deserve, which subscribes every year a considerable sum of money to the service of research and itself has on the whole no direct connection with science. There is no doubt that a reasoned appeal to the right people in this country will almost invariably be answered favourably.

Now to return to the main argument. You will find that there is a great need for efficient mechanics and glass-blowers, who are the driving force of most technique. There is no money available, and no place where they can learn how to become the really finished article. We can all do something—the appeal is so reasonable. What is required is the use of a small sum of money to release the full force of a very large one.

One of the tragedies of modern life is the lack of real interest of powerful people in science and research. An appaling amount of nonsense has, of course been talked about research as a panacea, as though you could go out and bring success by hiring a few mediocrities. Bacon noted the art of discovery as deficient, and so it still is, but the cause which I am pleading now is one of the certain factors of success—and an important one.

The other poiut worth discussion is how to make a start. The answer is to employ foreigners to begin with if you cannot find sufficient first-class home talent, and to educate your incoming personnel abroad if necessary. The number of people involved is so small, and the advantages to be gained so great, that political arguments, especially in the face of the utterly illogical character they assume on examination, may be safely disregarded. There are numerous branches of science whose progress could be greatly stimulated by closer contact with others, due in almost every case to advantages obtainable by exchange of technique. I have already dwelt at some length on the natural inherent oppositions which are a part of human nature. Here a great deal can be done by insistence on travel. Once again you may tell me that this is merely a matter of money, and that no money is available. To that I would again reply that it is far more a matter of the will to conquer than finding money. We all of us suffer from the most extraordinary inertia, and very frequently are unaware of first-class work, which may be going on two or three hundred yards from us, in another department. One of the factors contributing to this is what you might call the vertical organisation of modern life. The reason for this is obvious. Science has become most extraordinarily specialized, and so has industry. It is the easiest thing in the world for any busy man confronted with a particular problem to say that is a matter for such and such a department, or such and such a section of science. The result of this is to create almost a pontifical organization headed by the names of various sciences. I think that there is no question but that modern science lives far too much in water-

tight compartments. Let me give you an example. I am one of those few people who are rather diligent in attendance at the meetings of the Royal Society, and when I hear papers read on the "B" side—that is to say, the biological sciences—I am always struck by the amount of help which could be given to authors of papers if only there were a larger attendance of those Fellows who are interested in the physical sciences and who only attend on their own day. You will see that in accordance with the title of my lecture I am really arguing that technique should be a kind of mutual exchange among the various branches of science.

I am lecturing to the Institute of Metals. and so far my remarks have been entirely of a general character. Let us turn for a moment to examine the importance of technique to those engaged in the study of metals. Personalities are not always permissible, but I think that in this case they are. Let us take as an example your distinguished ex-President. Great as are his intellectual powers, if he were called upon, with his hand upon his heart, to make an estimate of how far his successful career had been influenced by the major inprovements in technique of which he has been the originator, and how far by sheer brain power, I think that he would say that technique had played a very important part indeed. You who are engaged in the study of metals are faced with problems of the most extraordinary difficulty, and which have brought forth in the last thirty years many brilliant solutions. I should like briefly to refer to one or two. First of all, let us take microscopy. Where would the modern metallurgist be without his microscope and its elaborate technique? Second, the induction furnace. The induction furnace is a comparatively new weapon, and one which is not used as much as it ought to be—mainly, I think, on account of its rather high initial expense in the larger sizes. Let me give an example of what I mean. We have in this country the British Cast Iron Research Association, which is doing most valuable work under considerable difficulties and yet is not equipped with a reasonable sized induction furnace. I venture to think that if this were otherwise discovery would advance at a much greater rate than it does at present.

(Concluded next week.)

—This address has been very slightly abbreviated in order to have it appear complete in two issues of this Journal.

Forthcoming Events, Etc.

ROYAL INSTITUTION.

21, Albemarle Street, London.

Friday, May 30, at 9 p.m.—"The Metal Crystal." By Sir H. C. Harold Carpenter, F.R.S.

SOCIETY OF GLASS TECHNOLOGY.

The next meeting of the Society will be held jointly with the Deutsche Glastechnische Gesellschaft and a party of members of that Society will be our guests from Monday, May 26th, to Tuesday, June 3rd.

The visiting delegation will be welcomed at Sheffield on May 26th, and between that date and June 1st will undertake a programme of works visitation and social engagements. Joint meetings of the Technical Committees of the Societies and the General Session for the reading and discussion of papers will follow on June 2nd and 3rd in London.

Owing to the number if the visiting party and to the fact that many of the firms whose works are to be visited are entertaining the visitors, it will not be possible for members of the Society to accompany the party on its tour through the country, unless they receive special invitations from the firms concerned. All members, however, will be welcomed to visit the Department of Glass Technology, at Sheffield, on the afternoon of May 26th.

A Special Appeal is made to members, however, to attend in large numbers the Welcome Luncheon at Sheffield, the Meetings on June 3rd, and the London Banquet on the evening of that day, and so assure our visitors of our appreciation both of their courtesy to our Society in 1928, and of the contributions which they also are making towards Glass Technology.

THE ROYAL SOCIETY.

Thursday, May 29th, 1930, at 4.30 p.m. —The Bakerian Lecture will be delivered by Prof. R. Robinson, F.R.S., on "The Molecular Structure of Strychnine and Brucine."

BRITISH INDUSTRIES FAIR SUCCESS.

A criterion of the success of the 1930 Fair, is that many of exhibitors in both London and Birmingham have already asked for increased space at next year's Fair. Numerous applications have also been received from manufacturers who did not exhibit this year.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, May 15, 1930.

The following papers were read :—

The Origin and Nature of Coal and Chars. By H. E. Armstrong, F.R.S.

On Some Short-Wave Equivalent Height Measurements of the Ionised Regions of the Upper Atmosphere. By E. V. Appleton, F.R.S., and A. L. Green.

The Liberation of Electrons from Metal Surfaces by Positive Ions. By M. L. E. Oliphant and P. B. Moon. Communicated by Sir Ernest Rutherford, P.R.S.

The authors describe some experiments on the action of positive ions upon metal surfaces, and attempt to explain the results obtained on the basis of modern theories of the metallic state.

When helium ions strike a metal surface they liberate electrons, the number depending upon the metal and the condition of its surface. With a gas-covered surface of molybdenum the emission is sensibly constant at about 30 per cent. of the ion beam, for ion energies below about 200 volts, but thereafter increases linearly to 120 per cent. at 1,000 volts. Emission from a hot degassed surface is much smaller, remaining at about 20 per cent. until ion-energy reaches 600 volts, when it increases rapidly to about 70 per cent. at 1,000 volts.

Velocity-distribution of electrons, liberated from a clean surface of molybdenum by positive ions of helium, shows a sharp cut-off at a lower limit of 2.3 volts, and a sharply defined upper limit at 20.2 volts. Maxima were observed in experimental curves at 2, 5, 6.8, 17.0 and 20.0 volts. Position of upper and lower velocity limits, and of peaks in the curves, did not vary much with energy of positive ions, though their relative magnitudes and sharpness changed considerably. Calculation shows that it is probable that a slow ion will capture an electron from a metal surface by auto-electronic emission of electrons, under the intense field of the approaching ion, while it is still several atom diameters from the surface. The same result follows from elementary considerations of the probability of the transition of an electron from a given state in the metal to a state of equal energy associated with the ion. Quantitative evaluation of the energies of the resulting system, and its probable action on the electrons in the metal, leads to a satisfactory explanation of the positions of the peaks in the experimental observations on the secondary emission, the range of energies being determined by the energy distribution of the electrons in the metal as given by the Sommerfeld theory.

The following papers were read in title only :—

On Some Simultaneous Observations on Downcoming Wireless Waves. By E. V. Appleton, F.R.S., and J. A. Ratcliffe.

A Comparative Study of the Excitation of Soft X-rays from Single Crystal Surfaces and from Polycrystalline Surfaces of Graphite and Aluminium. By O. W. Richardson, F.R.S., and U. Andrewes.

The curves obtained by plotting the photoelectric yield of the soft X-rays per unit thermionic current against the exciting primary voltage show discontinuous rates of increase at certain voltages which coincide with those which give similar discontinuities with the polycrystalline specimens. They are, however, fewer in number and tend to run in groups. The voltages at which the discontinuities occur appear to have a numerical structure resembling that which connects the null frequencies of baud systems. The crystal curves are steeper at moderate voltages and flatter at high voltages than the polycrystalline curves.

The Excitation of Soft X-rays from Some Polycrystalline Metal Surfaces. By O. W. Richardson, F.R.S., and S. Ramachandra Rao.

Measurements have been made of large numbers of soft X-ray critical potentials for cobalt, nickel, tungsten and pure and also impure copper and the values tabulated. The variation of the photoelectric yield with the magnitude of the thermionic current and with the inclination of the anticathode is examined. It is also shown that many of the inflections only appear after the targets have been heated to a high temperature.

The Excitation of Soft X-rays from a Single Crystal Face of Nickel. By O. W. Richardson, F.R.S., and S. Ramachandra Rao.

The soft X-ray critical potentials are measured for the 100 face of a nickel crystal. They are found to be less numerous than for polycrystalline nickel. The total yield is also lower at high and higher at low voltages with the crystal specimen.

Total Secondary Electron Emission from Polycrystalline Nickel. By S. Ramachandra Rao. Communicated by O. W. Richardson, F.R.S.

Total secondary electron emission from a polycrystalline nickel target has been in-

vestigated at applied potentials from 1 to 550 volts. Several peaks are obtained below 30 volts and a large number of inflections above 30 volts. There is satisfactory agreement with similar values of Petry and with the soft X-ray discontinuities of Thomas. The effect of bombarding in hydrogen is also studied.

Total Secondary Electron Emission from a Single Crystal Face of Nickel. By S. Ramachandra Rao. Communicated by O. W. Richardson, F.R.S.

Total secondary electron emission from the face 100 of a nickel crystal has been studied at applied potentials varying from 1 to 550 volts. The potentials at which inflections appeared agree very well with the soft X-ray discontinuities from the same crystal face obtained by Richardson and Rao.

The bearing of these results on the soft X-ray discontinuities is discussed.

The Emission of Secondary Electrons and the Excitation of Soft X-rays. By O. W. Richardson, F.R.S.

The mechanism of the origin of secondary electrons and of soft X-rays is discussed, particularly in view of the new experimental evidence published by U Andrewes, Ramachandra Rao, E. Rudberg and the author. The view is put forward that the first act is the excitation of a *structure* electron by the primary which is returned as part of the high energy group of secondaries. The low energy group and the X-rays result from the return of the excited structure electrons to the ground state. The agreement of the soft X-ray with the secondary electron breaks is accounted for, since both are excitation potentials of the structure electrons. The hypothesis gives a natural explanation of the band-like structure of the discontinuities already found empirically for C and Al and here extended to Ni. The soft X-ray data and the analysis of velocity distribution of secondary electrons for carbon have led independently to the same level differences as closely as they have been ascertained. All the levels found are shown to be of the order of magnitude to be expected theoretically.

Researches on the Chemistry of Coal. VI. By W. A. Bone, F.R.S., L. Horton, and S. H. Ward.

An experimental study of the oxidation of typical coals, of maturities varying from tertiary brown coal to carboniferous coking bituminous coal, has shown that in each case the main coal-substance can be readily oxidised by means of alkaline permanganate to carbonic anhydride, acetic, oxalic and benzene carboxylic acids, all but two of the possible benzene carboxylic acids having been isolated from the crude oxidation products. The percentage distribution of the carbon of the coal substance among the oxidation products is (approx.) 42 as carbonic anhydride, 2 as acetic, 7 as oxalic and 48 as mixed benzene carboxylic acids of mean composition approximating to that of benzene tricarboxylic acid; hence about one-third of the carbon of the coal substance appeared in C_6-rings of benzenoid acids.

It is also shown that (1) under "optimum conditions" the character and proportions of the various oxidation products do not vary much with the maturity and geological age of the coal, and (2) colloidal "humic acids" are formed as intermediate oxidation products. And it would appear that, whatever its chemical nature may have been, the "maturing" of coals has not destroyed the essential chemical structure of the main coal substance, however much it may have been modified in detail.

It has likewise been shown that the constituents of bituminous coals mainly responsible for their "coking propensities" are benzenoid in character, and that in all probability during the "maturing process" they developed from phenols and phenolic esters, found in immature brown coals.

Such results, revealing that coal substance —no matter of what geological age or chemical maturity—is essentially "benzenoid" in structure, suggest the possibility of its having arisen through condensations of phenolic- and amino- with aldehydic-bodies, much as "bakelite" is synthesised from phenols and formaldehyde.

Results show that on carbonising coals at various temperatures up to 1,000° C. their proportionate "benzenoid" structure first increases, attaining a maximum at about 500°-600° C., but afterwards diminishes, although a completely "carbonised" coke still retains some of it.

The Spread of Vorticity in the Wake Behind a Cylinder. By L. Rosenhead. Communicated by H. Jeffreys, F.R.S.

The trail of vortices in the wake behind a cylinder is taken to be a symmetrical double row of rectilinear vortices of circular section. The stability of such a system to three-dimensional disturbances is investigated and it is found that the increase in the diameters of the vortices is sufficient to account for the closing up and disappearance of the double row. This is put forward as a tentative explanation of what is seen in experiment in the trail behind a cylinder.

The paper also contains a discussion of the stability of an isolated rectilinear vortex of circular section to three-dimensional disturbances.

The Spectra of Trebly-Ionised Oxygen (O IV) and Trebly-Ionised Nitrogen (N IV). By L. J. Freeman. Communicated by A. Fowler, F.R.S.

About 50 lines in the spectrum of trebly-ionised oxygen (O IV) have been newly classified. All the doublet and quartet terms of principal quantum number 3 have been identified.

In the spectrum of trebly-ionised nitrogen (N IV), combinations of the $3p\ ^3P$ term with $3s\ ^3S$ and $3d\ ^3D$ have been observed. Provisional classifications have been given for four other lines.

The Group Properties of Dirac's Matrices. By G. Temple. Communicated by A. S. Eddington, F.R.S.

The paper gives an account of the group properties of a set of operators (A_1, A_2, A_3, A_4), with operand ψ, particularly with reference to a generalised form of Dirac's wave equation

$$\sum_n^4 p_n A_n\psi+(2\pi\iota mc/n)\psi=0,$$

in which the A's are not restricted to be matrices.

In virue of Dirac's conditions,

$$\tfrac{1}{2}(A_m\ A_n+A_nA_m)=\begin{cases}0, \text{ if } m\neq n,\\ 1, \text{ if } m=n,\end{cases}$$

these operators generate a group of order 32. When definite interpretations are assigned to the operators and operand, any two such groups are equivalent. The operators of such groups fall into two sets, of 16 each, differing only in sign, and forming two linearly independent sets of operators.

The transformation group of the wave operand ψ is obtained from the invariance of the wave equation. The invariants, 4-vectors and 6-vectors, having a certain quadratic form in ψ are then determined. It is found that there are only two linearly independent tensors in each class named above.

The Operational Wave Equation and the Energy Levels of the Hydrogen Atom. By G. Temple. Communicated by A. S. Eddington, F.R.S.

The operational wave equation for a free electron is

$$\sum_n p_n\ A_n\psi+\iota mc\psi=0,$$

where the p_n's are the quantum momentum- and energy-operators and the A_n's any perpendicular set of " wave-operators " acting on the operand ψ. The only restrictions placed on the A_n's are firstly, Dirac's conditions,

$\tfrac{1}{2}(A_m\ A_n+A_n\ A_m)=0$ or 1 as $m\neq n$ or $m=n$, and, secondly, the axioms introduced in a previous paper. The whole of the analysis of this paper is made without any further particularisation of the operators A_n. In an electromagnetic field, the operators p_n are replaced by p_n+G_n, (b_n) being proportional to the 4-vector potential of the field.

Dirac's methods can be modified and generalised to suit this extension of his linear wave equation, which is applied here to the problem of the undisturbed hydrogen atom. It proves possible to obtain the energy levels, quantum numbers and wave functions on the basis of our scanty knowledge of the A_n's and our complete ignorance of the nature of ψ. The " wave functions " obtained here are expressed in terms of a certain operand η, of which nothing is known but that it is annihilated by a certain operator ($F+\lambda$), defined in terms of the A_n's.

The Effect of Nuclear Spin on the Optical Spectra III. By J. Hargreaves. Communicated by R. H. Fowler, F.R.S.

In two previous papers the intensities of the multipled lines due to a nuclear spin have been given, together with the interaction energy of the nuclear spin and orbital momentum. In the present paper the interaction energy of the nuclear and electron magnets is calculated for the cases of nuclear spins of ½, 1, 1½, and 4½ quanta. In the case of the δ-levels this energy is zero, for although $\overline{1}/r^3\rightarrow\infty$ as regards integration with respect to r, yet the mean value of this over any sphere is zero. Interpreting Jackson's observations for cæsium we deduce that the magnetic moment of the nucleus is probably 0.5 $Ze/m'c$ times the spin.

A description is also given of the hyperfine structure of the Zeeman effect, and it is found that the " cosine " law holds. The results are compared with the observations for bismuth, and found to agree very well. In particular the validity of the empirical terms in the wave equations, which were introduced to account for the δ-terms, is amply justified.

On the Coefficient of Heat Transfer from the Internal Surface of Tube Walls. By A. Eagle and R. M. Ferguson. Communicated by G. G. Stoney, F.R.S.

The Interaction of Oxygen with Nitrogen after Collision with Electrons. By O. H. Wansbrough-Jones. Communicated by T. M. Lowry, F.R.S.

The Formation of Ozone from Oxygen after Collision with Electrons. By O. H. WANSBROUGH-JONES. Communicated by T. M. Lowry, F.R.S.

The Optical Rotatory Power of Quartz on Either Side of an Infra-Red Absorption Band. By T. M. LOWRY, F.R.S., AND C. P. SNOW.

Problems of the Boundary State. By SIR WILLIAM HARDY, F.R.S.

The n-Fatty Acids. By F. FRANCIS, S. HARVEY PIPER AND T. MALKIN. Communicated by M. W. Travers, F.R.S.

The Wake in Three-Dimensional Fluid Flow. By H. JEFFREYS, F.R.S.

The Raman Spectra of Some Aldehydes and of Mesitylene. By S. VENKATESWARAN AND S. BHAGAVANTAM. Communicated by Sir Venkata Raman, F.R.S.

The Density and Compressibility of Phosphine Gas: the Atomic Weight of Phosphorus. By M. RITCHIE. Communicated by Sir James Walker, F.R.S.

The Absorption Spectrum of Chlorine. II. By A. ELLIOTT. Communicated by O. W. Richardson, F.R.S.

The Scattering of Electrons by Atoms. By N. F. MOTT. Communicated by W. L. Bragg, F.R.S.

Scattering of Fast Electrons and Nuclear Magnetic Moments. By H. S. W. MASSEY. Communicated by R. H. Fowler, F.R.S.

An Application of the Stern-Gerlach Experiment to the Study of Active Nitrogen. By L. C. JACKSON AND L. F. BROADWAY. Communicated by A. P. Chattock, F.R.S.

THE CHEMICAL SOCIETY.

Thursday, May 15.

Adsorption of Silicic Acid Gel in the System n-Butyl Alcohol-Benzene. By D. C. JONES AND L. OUTRIDGE.

The apparent adsorption curve has been studied throughout the complete range of equilibrium concentrations. The results have been discussed from the point of view of the equation of Williams, and a method devised for obtaining the true adsorption according to Williams, in the case of silicic acid gel, without any further experimentation. This method has been confirmed by vapour adsorption experiments. The results are in argeement with the views of Ostwald and Izaguirre that the apparent adsorption curve can be satisfactorily interpreted if the true adsorption of both compenents is expressed by a Freundlich isotherm. The differences between the values of the true adsorption, according to the equations of Williams or of Ostwald and Izaguirre respectively, are attributed to capillary adsorption. The concentration of the solution thus adsorbed has been shown to be equal to that of the equilibrium solution, in agreement with theory.

The Dielectric Strength of Some Explosive Mixtures Containing Carbonic Oxide. By B. W. BRADFORD AND G. I. FINCH.

An account was given of an experimental determination of the dielectric strengths of dry and moist "detonating gas" ($2CO+O_2$) and of dry "detonating gas" containing a small amount of hydrogen. The results establish that (i) drying increases the dielectric strength of "detonating gas," (ii) small additions of hydrogen reduce, but do not inhibit, this effect, and (iii) successive small additions of steam to dry "detonating gas" at first reduce and then increase its dielectric strength.

It is shown, further, that Smithells, Whitaker, and Holmes are not justified in drawing the conclusion that hydrogen is more effective than water vapour in conferring ignitability upon "detonating gas."

The System Cyclohexanol and Water. By N. V. SIDGWICK AND L. E. SUTTON.

The system *cyclo*hexanol and water has been examined over a range of *cyclo*hexanol concentration 0-93 per cent. by weight; it consists of a two-liquid phase region, with reverse solubility on the water side and an upper critical solution temperature, intersected on either side by ice-lines. The results do not confirm the existence of the hydrate $C_6H_{12}O, 0.5H_2O$ which was suggested by de Forcrand (*Compt. rend.*, 1912, *155*, 118).

The Effect of Alkyl Substitution on the Stability of the Dimalonatocupriate Ion. By H. L. RILEY.

The tendency of the malonate ion to coordinate with the copper ion and form the ion $[Cu(CH_2.C_2O_4)_2]^{--}$ has already been reported in Part II of this series. The work has now been extended to the alkyl-substituted malonate ions. The following results have been obtained. The groups CH_3, C_2H_5, and n-C_3H_7 have little effect, causing a slight decrease in the tendency to co-ordinate with copper. The group *iso*C_3H_7 causes a relatively large increase in the tendency, the group $(CH_3)_2$ causes a relatively large decrease and the groups $(C_2H_5)_2$ and $(n\text{-}C_3H_7)_2$ cause a still larger and approximately equal decrease. This change in the tendency of these ions to co-ordinate with the copper ion is accompanied by certain changes in the properties of the normal copper salts. The methyl, ethyl, and *n*-propyl substituted copper malonates are

pale blue in colour, similar to copper malonate, whilst the *iso*propyl and dimethyl salts are deep blue and the diethyl and dipropyl compounds are green.

SOCIETY OF PUBLIC ANALYSTS.

An Ordinary Meeting of the Society was held at the Chemical Society's Rooms, Burlington House, on Wednesday, May 7, the President, Dr. J. T. Dunn, being in the chair.

Certificates were read for the first time in favour of John Herbert Bushill, M.Sc., A.I.C., Edward Quentin Laws, B.Sc., A.I.C., and Hubert Taylor, B.Sc., A.I.C.

Certificates were read for the second time in favour of Lionel Stuart Davis, Arthur Smith, B.Sc., A.I.C., and Snow Blagburn Tallantyre, B.Sc., A.R.C.Sc., F.I.C.

The following were elected members of the Society :— Charles Ambrose Adams, B.Sc., F.I.C., Janet Warden Brown, Ph.D., A.I.C., and John Alexander Reddie, F.I.C.

The following papers were read and discussed :—

The Diastatic Activity of Honey. By L. H. Lampitt, D.Sc., F.I.C., E. B. Hughes, M.Sc., F.I.C., and H. S. Rooke, M.Sc., A.I.C.

Honey diastase behaves in a similar way to other enzymes under varying conditions of temperature and pH, the optimum pH for both the dextrinogen-amylase and the saccharagen-amylase being about 5.3. The maximum dextrinogenic power is obtained at about 40° C. The amounts of reducing sugars formed increase with time, but after 16 hours the increase is slow.

A New Method for the Separation of Titanium from Zirconium and Hafnium. By A. R. Powell and W. R. Schoeller, Ph.D.

The present position of the titania-zirconia separation is reviewed, Dittrich and Freund's salicylate method being re-investigated. In the authors' hands, the process did not lead to a clean-cut separation, the zirconia residue from a double treatment still containing titania, while some zirconia accompanied the titania into the filtrates. A new method is explained, based on precipitation of the titania by tannin from a neutralised oxalate solution self-saturated with ammonium chloride : a repetition of the procedure results in the quantitative precipitation of the titania with only traces of zirconia, if any. The method is simpler and quicker than the published processes. A preliminary account is given of the extension of the earth acids and/or titania from any or all of the following :— zirconia, thoria, and alumina.

The Composition and Polymerisation of Chinese Wood (Tung) Oil. By E. R. Bolton, F.I.C., and K. A. Williams, B.Sc., A.I.C.

The authors confirm the value of Toms's method of determining the elaeostearic acid in tung oil by the difference between the iodine value obtained by the bromine vapour method and that obtained by the action of Wijs solution until four of the six bonds are saturated. This figure may be obtained with sufficient accuracy for practical purposes by an absorption limited to 20 minutes, but a more accurate method is described. The elaeostearic acid glyceride calculated in this way corresponded with the amount of polymerisable matter separated by the authors' method of extraction, and for the oils examined ranged from 70 to 74 per cent.

The Examination of Milk for Tubercle Bacilli. By D. R. Wood, F.I.C.

A survey is given of the experience and results obtained in the examination of 1,000 herds in the County of Somerset during the last four years. The relative value of microscopical and biological tests is discussed, and experiments on the cytology of tuberculous milk are described. The limitations of veterinary inspection are pointed out, and the conclusion is drawn that the present methods are inadequate for the elimination of tuberculous milk.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

13,126.—Graesser - Monsanto Chemical Works, Ltd., & Mather, E.—Production of oxy-benzoic acids, etc. April 29.

13,313.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of halogenated cyclic ketones of the acenaphthene series. April 30.

13,356.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of acridine deriva-

13,610.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of N-substituted 5.6-dialkoxy - 8 - amino - quinolines. May 2.

13,035.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of hydrocarbons. April 28.

Specifications Published.

328,272.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of potassium nitrate.

328,292.—Major & Co., Ltd., Hinchcliffe, H. H., and Darby, W. J.—Manufacture of azo dyestuffs.

328,334.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of vat dyestuffs.

328,418.—Imperial Chemical Industries, Ltd., and Allchin, L. J.—Manufacture of m-2-xylidine.

319,656.—I. G. Farbenindustrie Akt.-Ges. —Process for the production of chemically pure phosphoric acid.

Abstract Published.

326,487.—Dyes; intermediate products. (Du Pont de Nemours & Co., E. I.; Wilmington, Delaware, U.S.A.).

1 : 9-*Anthrathiazole-2-carboxylic chloride* is made by heating 1-chloranthraquinone-2-carboxylic acid with alkaline polysulphide and ammonia, and converting the resulting 1 : 9-anthrathiazole-2-carboxylic acid into the chloride, for example by means of thionyl chloride or phosphorus pentachloride. An example is given.

Vat dyes, dyeing in yellow to orange shades, are obtained by condensing the above 1 : 9-anthrathiazole - 2 - carboxylic chloride with aminoanthraquinones or their derivatives, including mercapto, benzoylamino, and halogen derivatives. The condensation may be effected by heating in nitrobenzene. In examples, the chloride is condensed with 1- and 2-aminoanthraquinones, monobenzoyl-1 : 5-diamino-anthraquinone, 1-amino - 6 - chloranthraquinone, and 1-mercapto-2-aminoanthraquinone in molecular proportions, and with 1 : 4- and 1 : 5-diaminoanthraquinones, one molecular proportion of the latter being condensed with two molecular proportions of the chloride. In a further example the chloride is condensed with 1 : 5-diaminoanthraquinone in molecular proportions and the product is benzoylated by treating with benzoyl chloride.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

The Latest TRADE MARKS

This list of Trade Marks of interest Readers has been selected from the Offic Trade Marks Journal, and is Published permission of the Controller of I Majesty's Stationery Office.

BEWOID.

511,103.—Chemical substances used in m ufactures, photography or phi sophical research, and anti-cor sives.—Becker and Co., (19 Ltd., 34 to 40, Ludgate Hill, L don, E.C.4. April 16th.

NORTHERN STAR.

511,147.—Carbide of Calcium.—The Halfc Cycle Co., Ltd., 239, Corporati Street, Birmingham. April 16

ORONITE.

509,483.—All goods in class 2 which incluc chemical substances used for ag cultural, horticultural, veterin and sanitary purposes.—Stand Oil Company of California, St dard Oil Building, 225, Bu Street, San Francisco, Californ United States of America. Ap 16th. (Associated).

TUNGURAN.

511,581.—All goods in class 1 which incluc chemical substances used in manufactur photography, or philosophical search and anti-corrosives.—I. Farbenindustrie Aktiengesellscha Mainzerlandstrasse 28, Frankfo on-Main, Germany. May 7th.

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THE TRANSPOSITION OF SILVER BROMIDE BY MEANS OF A SODIUM CHLORIDE SOLUTION.

By L. J. CURTMAN AND S. S. LEIKIND.

When boiled with a 5 per cent. sodium chloride solution, silver thiocyanate may be transposed to sodium thiocyanate and silver chloride[1]. Under the same conditions silver iodide remains practically unchanged. That the above reaction is able to take place may be qualitatively ascribed to the fact that the solubility product of silver thiocyanate is about 13,000 times greater than that of silver iodide. Calculation also shows that the solubility product of silver bromide is about 9,000 times that of silver iodide. Since the above large numbers expressing solubility product ratios are roughly of the same order, it was seen by one of the authors (L. J. C.) that the reaction used to transpose silver thiocyanate might be employed to good advantage in transposing silver bromide. Experiments performed later confirmed this observation. With thiocyanate and bromide separated from iodide and chloride, the detection of all four acids may be rapidly accomplished[2].

It was the purpose of this investigation—

To establish the optimum conditions for the transposition of silver bromide in the presence of comparatively large amounts of silver iodide.

To determine the extent of the transposition of varying amounts of silver bromide.

In our procedure[2], bromine is liberated from bromide by means of potassium permanganate in a sodium chloride solution acid with sulphuric acid and detected by extraction with carbon tetrachloride. Since chlorine may also be liberated in a similar manner, it was our first task to establish conditions whereby bromine alone would be liberated. That these conditions constitute a necessity is evident when the following are considered : (*a*) Free chlorine colours the carbon tetrachloride layer; (*b*) chlorine, if simultaneously liberated with bromine, is likely to convert the bromine into colourless bromine chloride and possibly bromate, rendering the test for bromine in either case less delicate.

After much experimentation, it was found that bromine is best liberated without affecting chloride from a volume of solution which is 0.6/N with respect to sulphuric acid. One cubic centimetre of 0.1/N potassium permanganate (or more as the occasion requires) is included in this volnme as the liberator of the bromine.

Influence of the Concentration of Sodium Chloride on the Transposition of Silver Bromide.

To study the influence of the concentration of sodium chloride on the efficiency of the transposition of silver bromide, in the presence of a comparatively large amount of silver iodide, a series of experiments was performed in which the amounts of the acids indicated in Table I were precipitated with

[1] Curtman and Harris. *J.A.C.S.*, 1916, 38,

[2] A paper describing this procedure will be

10cc. of 0.25/N silver nitrate, from a volume of 65 cc. (this is an average volume realised in our procedure). Ten per cent. of the volume of concentrated nitric acid was now added. The mixtures were stirred, heated to boiling, filtered and washed free of silver *precipitates were now transferred to 100 cc.* nitrate. With the aid of a spatula, the beakers and to each were added 10 cc. of sodium chloride solution of concentration indicated in the table. The mixtures were now gently boiled with constant stirring for two minutes[3] and filtered hot. The residues were washed three times with boiling water. The washings and the filtrate i each case were combined, boiled down t 10 cc., and transferred to test tubes an cooled. To each tube were now added 2 cc carbon tetrachloride, 3 cc. 3/N sulphuri acid, 1 cc. 0.1/N potassium permangan ate and the volumes in the tubes made u to 15 cc. (the latter volume was exclusiv of the volume occupied by the carbon tetra chloride). The tubes were now shake vigorously for 30 seconds, stoppered, an the colours in the carbon tetrachlorid layers compared. The results are given i Table I.

TABLE I.

Study of the Influence of Sodium Chloride Concentration on the Transposition of Silver Bromide.

No.	MgBr	MgI	Conc. NaCl	Results (Colour CCl_4).
1-2	4	250	2N	B[4]
3	0	250	2N	Colourless
4-5	4	250	N	D
6	0	250	N	Colourless
7-8	4	250	0.5N	C
9	0	250	0.5N	Colourless
10-11	4	250	.25N	E
12	0	250	.25N	Colourless
13-14	4	250	5%	A
15	0	250	5%	Colourless

Conclusion : It is evident from the table that the best results are obtained by using 5% sodium chloride.

Influence of Volume of Sodium Chloride on the Transposition of Silver Bromide.

To determine the influence of volume of 5 per cent. sodium chloride on the transposition, the above experiments were repeated, varying the volume of 5 per cent. sodium chloride. The results are recorded in table II.

Study of the Influence of Volume of 5 per cent. Sodium Chloride on the Transposition of Silver Bromide.

TABLE II.

No.	MgI	MgBr	Vol. 5% NaCl cc.	Results.
1-2	250	4	10	A[4]
3	250	0	10	Colourless
4-5	250	4	15	B
6	250	0	15	Colourless
7-8	250	4	20	C
9	250	0	20	Colourless
10-11	250	4	25	D
12	250	0	25	Colourless

Conclusion : It is clear from the above, that 10 cc. is the best volume to use for the transposition. The results obtained in our preliminary work led us to adopt the following procedure for the transposition of silver bromide. Gently boil the washed silver precipitate, with constant stirring, for two minutes with 10 cc. of 5 per cent. sodium chloride. Filter and proceed as above.

[3] This time of boiling had been experimentally found to give the best results in the transposition.

[4] The capital letters describe the intensity of the colour of the carbon tetrachloride layer. Thus A represents the darkest colour (greatest transpositon), while E denotes the weakest colour.

The Extent of the Transposition of Silver Bromide.

Our next task was to determine the extent of transposition of varying amounts of silver bromide. In these experiments the indicated amounts of bromide were precipitated as the silver salts, washed and severally transposed with 10 cc. of 5 per cent. sodium chloride. The mixtures were filtered into volumetric flasks (the proper volume of dilution having been empirically determined). The precipitates were now washed with hot water and the washings added to the flasks until the volume mark was reached in each case. The flasks were now allowed to cool and the volumes were again made up to mark. With the aid of a pipette, 10 cc. of solution were drawn off from each flask and transferred to test tubes. Two cc. of CCl_4, 3 cc. of 3/N sulphuric acid and 1 cc. of 0.1/N potassium permanganate were added to each tube and after making up each volume to 15 cc. they were vigorously shaken for 30 seconds, allowed to settle and compared with blanks in which known amounts of bromine had been liberated. Thus, if 100 mg. bromine as silver bromide were transposed, filtered, and the filtrate diluted up to 100 cc. and if the bromine liberated from a 10 cc. portion corresponded to that of a 2mg. blank, it is readily seen that 20 mg. of bromine as silver bromide had been transposed. Therefore, the transposition had proceeded to the extent of 20 per cent. The results of these experiments are given in Table III.

The Transposition of Silver Bromide.

TABLE III.

No.	MgBr as AgBr.	Dilution	MgBr in 10cc. Portion	Total MgBr transposed	Per cent. Transposed
1	20	50cc.	1.1	5.5	27
2	40	100cc.	0.8	8	20
3	60	100cc.	1.2	12	20
4	80	100cc.	1.2	12	15
5	100	100cc.	2	20	20
6	120	100cc.	2	20	17
7	140	100cc.	2	20	14

Conclusion: Table III shows that the extent of transposition of silver bromide depends up to a certain point on the *initial amount of solid silver bromide present.* With 100 mg. bromide and over, the same amount is always transposed.

Influence of Silver Iodide on the Transposition.

A series of similar experiments was now performed to determine the effect of varying amounts of silver iodide on the transposition. The amount of silver bromide was kept constant in each experiment and was equivalent to 100 mg. bromide. The results are given in the table below.

Effect of Silver Iodide on the Transposition of Silver Bromide.

TABLE IV.

No.	MgI as AgI	Dilution	MgBr in 10cc. portion	Total MgBr Transposed	% Silver Bromide Transposed
1	0	100cc.	2	20	20
2	20	100cc.	2	20	20
3	40	100cc.	0.9	9	9
4	60	100cc.	0.9	9	9
5	80	100cc.	0.4	4	4
6	100	100cc.	0.4	4	4

Conclusion: It is evident that small amounts of silver iodide (up to that equivalent to 20 mg. of iodide) do not affect the efficiency of the transposition, but with larger quantities, the percentage of silver bromide transposed is decreased.

SUMMARY.

1.—In the presence of large amounts of silver iodide, the maximum transposition of silver bromide may be effected by boiling the silver precipitate for two minutes with 10 cc. of 5 per cent. chloride.

2.—Under the above conditions the percentage transposition of different amounts of silver bromide (when present alone) varies from 14-27 per cent.

3.—Amounts of silver iodide equivalent to 20 mg. iodide are without influence on

the transposition. The presence of larger amounts of silver iodide diminishes the percentage of silver bromide transposed.

College of the City of New York,
New York City.

ON THE DISPERSION OF SILVER HALIDES THROUGH AQUEOUS MEDIUM.

CONTRIBUTION TO THE STUDY OF PHOTOGRAPHIC CHEMISTRY: REPORT 1.

By TSUNEO SUZUKI.

General.

To newly precipitated silver bromide, which has been prepared by adding aqueous solution of silver nitrate to excess of aqueous solution of potassium bromide, and washed with water three or four times, some water is added, and then a little of aqueous or alcoholic solution of any of the colouring matters or alkaloids, etc., which shall be mentioned in subsequent pages, is added, and is strongly shaken. Then we observed that the precipitated silver bromide is quickly dispersed through the aqueous medium, and the whole became a milky suspensoid. On examining a drop of this liquid under a microscope, we observed that small grains of silver bromide were distributed through the liquid, of the size from almost invisible to 1-2 μ in diameter; and that they were swimming in the liquid showing Brownian motion.

This curious fact[1] which has not yet been noticed by any, can also be observed in the case of silver chloride, iodide and cyanide, and also of newly precipitated mercurous and thallous chloride.

To disperse precipitated silver bromide through aqueous medium, the following procedure is very convenient:—

Prepare 2N. solution of potassium bromide and N. solution of silver nitrate. Take equal volumes of these solutions, say each 6cc., and add silver solution to that of bromide (small quantity at a time), and shake well after each addition. After all silver solution has been added, add excess of water and shake well. On standing, the precipitated silver bromide will settle very quickly to the bottom, leaving slightly turbid liquid above the precipitate. Pour off this liquid from the precipitate, and add fresh water again and shake well. After the precipitate of silver bromide had settled down, we observed that the supernatant liquid was almost clear. Pour off this liquid again, and repeat the washing.

At the latter stage of washing, the liquid above the precipitate will be found to be a little turbid owing to slight dspersion of silver bromide through water which contains no or very little soluble salts such as potassium bromide or nitrate. When this stage is arrived, which can be attained by three or four times washing with ordinary or distilled water, pour off the supernatant liquid as completely as possible from the precipitate, add 20 to 30 cc. of water (more can be added, of course, without any sensible action to the subsequent dispersion), then add any of the alcoholic or aqueous solutions of substances which are described in the subsequent pages. For instance, add 1 cc. of alcoholic solution of brucine 1 : 100, and shake strongly. Then we shall notice that the precipitate of silver bromide which was formerly settling at the bottom in curdy form is now completely dispersed through the liquid in fine grains forming a kind of suspensoid, and consequently the liquid becomes milky. Instead of brucine, some colouring matter can be used. For example 2cc. of 1 per cent. aqueous solution of pure erythrosine (sodium salt of tetra-iodofluorescein), or 1cc. of 1 per cent. alcoholic solution of orthochrom may be used for the precipitate obtained from 6cc. of normal solution of silver nitrate. On using different colouring matters, the fine grains of silver bromide are differently coloured, each special to the colouring matter used, and we obtain suspensoids of coloured silver bromide.

On pouring the milky liquid into a large quantity of water kept in a beaker, a beautiful cloudy apearance is seen during the mixing of these two liquids. On standing for a long time in a dark place, the fine grains settle gradually down to the bottom; but in the light, the settling is usually accompanied by a change of colours.

SUBSTANCES WHICH CAUSE THE DISPERSION: DISPERSING AGENTS.

All of the colouring matters called colour sensitizers and desensitizers (for silver bromide gelatine plates) which are at my disposal make silver bromide disperse, when they are added in small quantity to the precipitate kept in water. Seemingly, there is a minimum limit of the quantity of those

[1] This fact was utilised by the author for preparing photographic emulsions: Japanese patent No. 65904; Kogyo Kwagaku Zasshi (*Journ. of Industrial Chem.*, Japan, 1925, 28, 584.

substances which is necessary to disperse a certain quantity of silver bromide precipitate through aqueous medium. It is very difficult to estimate the exact proportions of these substances to silver bromide, because of the uncertainty of observation of exact point where the precipitate of silver bromide is completely dispersed through water. When the quantity of the dispersing agent added is insufficient, only a part of the precipitate is dispersed, whilst the other part still remains as precipitate even after violent shaking. The exact point which is to be observed is that, after shaking, no precipitate of silver bromide at the bottom of the vessel accumulates on standing for a little while. To observe this point, which is not so sharply marked, is a matter of some difficulty. In the case of colouring matters the observation is a little easier, owing to the fact that the dispersed grain is coloured but the remaining precipitate still retains the original yellowish colour. So the presence of uncoloured precipitate at the bottom shows the quantity of dispersing agent added being still insufficient. Notwithstanding that observation, which is to distinguish two different phases in a turbid medium, is a very rough one. Trustworthy numbers can only be found by repeatin gthe experiments.

Among colour sensitizers and desensitizers a few of them were subjected to estimation. The experiments were made just in the same way as is described in the foregoing articles. Each alcoholic or aqueous solution of those colouring matters, mostly 1 per cent solutions if the case may permit, is added to the precipitated silver bromide kept in 20—30 cc. of water, a few drops at a time, each addition being succeeded by a violent shaking, till all the precipitate of silver bromide is dispersed through the medium. From the volume of solutions used, the minimum quantity of dispersing agents was calculated. The numbers given here are the numbers of centigrams necessary to disperse silver bromide made from 6 cc of normal solution of silver nitrate, *i.e.*, 1.02 gram of silver nitrate. For the sake of brevity, I will call the number "dispersion number of substance for silver bromide," or sometimes simply "dispersion number."

The dispersion number[2] for silver bromide is not markedly affected by the change of room temperature, and also not by the small change of volume of the medium. The results of estimation are as follows :—

Name of substances	Dispersion numbers.
Illuminol R[3]	0.7
Illuminol G[4]	0.4
Phenosafranin HClide	0.5—0.7
Erythrosine P[5]	1.7
Rose Bengale	1.7
Rohdamine HClide[6]	0.8
Orthochrom[7]	0.8
Pinachrom[7]	0.5
Dycyanin[8]	2.1
Safranine T[9]	0.3
Pinachrom Violet[7]	0.3
Pinakryptol[10]	0.8
Pinacyanol[11]	0.5

To the above named colouring matters, many can be added as dispersing agents such as all the colour sensitizers made by Ogata, Sakurai and Sebe; and, moreover, the colour sensitizers, alizarin blue and eosine (the latter in presence of traces of soluble silver salt) belong to this class of substances, and also methylene blue and tetraiodophenolphthalein, which are not good sensitizers, show the same property. The number of these colouring matters may increase as my experiments advance.

Among common alkaloids, brucine in its basic form, and quinine as its salts, have marked power of dispersing silver bromide through aqueous medium. The estimation of dispersion number of alkaloids was made in just the same way as in the case of colouring matters. The dispersion numbers found are as follows :—

[2] When the condition of making the precipitate of silver bromide is different, the dispersion number may differ too; *vide infra.*

[3] Japanese Patent No. 65706; Ogata and Sebe, Ogata, a carbocyanine.

[4] Japanese Patent No. 65074; Ogata and Sebe, an isocyanine.

[5] Pure sodium salt of tetraiodofluoresceïn, prepared by me in this institute, and supplied to the public for photographic use.

[6] *Ber.*, 32, 2122.

[7] Sensitising colouring matters prepared by "Höchster Farbwerke" isocyanines and cyanines, ROWE'S COLOUR INDEX, 1st Ed., p. 202.

[8] Prepared by "Höchster Farbwerke"; ROWE'S COLOUR INDEX, 1st Ed., p. 203.

[9] Commercial article.

[10] A desensitizer prepared by "Höchster Farbwerke."

[11] Prepared by "Höchster Farbwerke," a cyanin colour, ROWE'S COLOUR INDEX, 1st Ed., p. 203.

Name of substances	Dispersion numbers.
Quinine hydrochloride	0.9—1.0
Cinchonine hydrochloride[13]	10.0
Papaverine, free base	0.8—10
Strychnine, free base	5.6
Brucine, free base	1.0
Berberine hydrochloride	3.0

To these, I may add laudanosine which is a very good dispersing agent. The number of alkaloids which disperse silver bromide shall also increase as my experiment continues.

It is a noticeable fact that the construction of the above named alkaloids suggests some interesting relation to the colour sensitizers belonging to cyanine groups, by the existence of rings like quinoline and its isonmers; but at present, I have no means to go further in this direction.

Attempts were made to find out any sensitizing action of these alkaloids, like that of cyanine colours, upon silver bromide gelatine plates : Photographic plates were dipped into the dilute solutions of these alkaloids (1 :25,000) for about four minutes, dried and exposed to the spectrum of iron arc produced by a quartz spectograph. After developing, any marked differenee from ordinary plates was studied, but neither in the visible nor in the ultra-violet part of the spectrum was there any difference.

The same dispersing action was observed among the compounds of uric acid series and their derivatives. Uric acid, theobromine, theophylline, thiosinamine[14] and murexid are to be included. The increase of the number of these compounds may also be expected.

Gelatine, which is universally believed to be the most important sensitizer for silver grains in photographic dry plates, albumin from hen's egg, agar-agar, starch, dextrin and chlorophyll were found to cause the dispersion of silver bromide just like the colouring matters and alkaloids. Perhaps, other albumins, albuminoids, and many mucilaginous compounds like gums and hexosans may also belong to this class of effective agents.

Almost the same phenomena can be observed in the case of silver chlorides, iodide and cyanide. Mercurous chloride and thallous chloride, made by precipitating corresponding salts with alkaline chloride show also the same phenomena. The feature of dispersing agents is a little different in these cases. For example, eosin is a very good dispersing agent for precipitated silver chloride, but for bromide and iodide only in presence of traces of soluble silver salts. These facts relating to other halides shall be published in future.

SOME PROPERTIES OF SILVER BROMIDE SUSPENSOID MADE BY DISPERSION.

The milky liquid prepared by this dispersion process becomes clear on standing in a dark place; the grains settle down to the bottom. On shaking, the original condition may again be restored. Putting the diluted suspensoid in a long glass tube, it was placed in a thermostat kept at 25°, with a view to estimating the falling velocity of the grains. The speed was very slow at first; 1 or 2 mm. per hour. But on the next morning, it was found that all of the grains settled to the bottom leaving a clear liquid above them. This seems to be due to the flocculation or agglomeration of silver bromide grains forming flocks of bigger size which settle more rapidly to the bottom. The flocculation of the grains could be observed under a microscope, but no sign of the growth of the grains themselves was observed; *i.e.*, no sign of ripening was observed. The size of the grains can be controlled within a certain range at the stage of making the precipitate of silver bromide. When excess of hot solution of potassium bromide is precipitated with hot solution of silver nitrate, and the mixture containing the precipitate is placed upon a water bath for a few minutes, on washing and dispersing, we obtain from that precipitate a coarse suspensoid of considerably larger grains than from the precipitate obtained by precipitating excess of cold solution of potassium bromide with cold solution of silver nitrate, and washing immediately. Under a microscope, we can distinguish the great difference of the size of the grains in both cases. If we use a colourless dispersing agent like brucine, the former precipitate gives a suspensoid of yellowish colour which settles very rapidly, whilst the latter gives almost milky white suspensoid which settles only after the lapse of a long time.

If we assume that the dispersion is causec by the adsorption of dispersing agents or the surface of grains, the dispersion numbe may differ when the condition of making th precipitate is different. When the total sur face of grains is larger we must certainly us more dispersing agents. The experiment i this direction is not yet tried and for the dis persion numbers given in the foregoing arti cles, it should be understood that they wer

[13] Still insufficient.

[14] Thiosinamine is believed to give a high sensitivity to dry plates; Sheppard, U.S. Pat. 1,574,943. Kodak, Brit. Pat., [illegible]

estimated for the precipitate made according to the conditions which were described in the first chapter.

These phenomena of dispersion of silver bromide which have hitherto been described, show that the dispersion is possibly the separation of the grains or small crystals of silver bromide of which the original precipitate was composed, and not the formation of new grains from the precipitated mass. When examined under a microscope, the precipitated silver bromide is found to be the agglomeration of small grains or crystals. By the addition of dispersing agents, the grains are put asunder and give rise to the formation of a suspensoid.

The suspensoid of silver bromide is easily broken or brought to flocculation by adding a little of a solution of alum. Those made by dispersing with basic substances like brucine, strychnine, cyanine colours and dicyanin, or others as erythrosine, rose bengale, phenosafranin and pinakryptol are broken by adding a small quantity of acids. Those made by quinine and berberine hydrochlorides and rhodamine hydrochloride are broken by the addition of a little ammonia or other alkali. Those made by erythrosine and rose bengale are easily broken by adding a very small quantity of potassium bromide. All of those which have once been broken cannot be brought again to the original condition simply by shaking.

On standing in diffused daylight, all suspensoids except those made by desensitizers, such as phensafranin and pinakryptol, change their colour quickly. The tint and speed of its change are different for each dispersing agent used; but in general, dark violet changes finally into dirty gray. Those made by sensitizing colours lose at the same time the original colour and on standing, the supernatant liquid acquires each different but dirty coloration. This change can be carried out, if the quantity of suspensoids is small, within a few seconds when the flasks containing the suspensoids are shaken under direct sunlight. The same change can be brought about by an ordinary electric lamp but in longer time extending to many hours. Those made by desensitizers do not change the colours of the grains as well as those of the supernatant liquid unless the exposure continues for a long time. In the case of using alkaloids, only the change of the colour of grains was observed.

Cataphoresis showed that the grains are negatively charged, but this was made in daylight, and must be repeated in the dark to eliminate the action of light.

When the grains, made by dispersing with different substance, are precipitated on glass plates ,or applied on glass plates by means of gelatine or agar-agar as binding material, they give when exposed in camera, developable pictures; those made by the desensitizers must be exposed for a very long time.

SUMMARY.

1.—Among widely different classes of substances, there are many which disperse precipitated silver bromide through aqueous medium.

2.—Each of these substances seems to have a minimum limit of quantity which is necessary to disperse a certain quantity of precipitate of silver bromide.

3.—The dispersion is only the disintegration of agglomerates of grains which constitute the flocculent precipitate of silver bromide and is not the formation of new grains.

4.—The size of silver grains can be controlled to some extent by making the precipitate of silver bromide under different conditions.

5.—The suspensoids made by dispersion are not permanent; the grains settle down by flocculation on standing. The original condition can be restored simply by shaking.

6—The suspensoids are broken either by acids or alkalis, or by some salts.

7.—All sensitizers and desensitizers for silver bromide gelatin plates are probably good dispersing agents for silver bromide precipitate.

8. There are many substances including colouring matters which disperse silver bromide well, but show no remarkable sensitizing or desensitizing action upon silver-bromide plates.

9.—The colour of suspensoids made by using colour sensitizers is very unstable to light, whilst that of suspensoids made by desensitizers is more stable.

10.—The grains of silver bromide made by dispersion are acted upon by light and they can be developed afterwards.

11.—The same phenomena of dispersion are observed also in the case of other halides of silver, and of precipitated mercurous and thallous chlorides.

CONCLUSION.

The curious property to cause silver bromide and other halides to disperse through aqueous medium seems to be not a rare but somewhat common property of substances belonging to widely different classes of compounds : these include colouring matters, alkaloids, uric acid derivatives, albuminous, and gelatinous and mucilaginous compounds.

It may be expected that many other substances will in time be found to have the same property. This dispersion which is probably caused by the adsorption of different substances on the grains of silver bromide and other halides seems to have a close relation to their sensitivity to light, and the fact that the sensitizers, and desensitizers are all dispersing agents for silver bromide, suggests that its sensitizing or desensitizing action is caused by some force or action exerted by these substances which are in close contact with the grains of silver bromide.

At present, owing to the scarcity of facts and lack of detailed experiments at hand, I am only able to say that the property to disperse precipitated silver bromide through an aqueous medium is, in all probability, a necessary condition of substances to be the sensitizers, or desensitizers for silver bromide, but other features are involved.

The unstability of colours of the suspensoids made by colour sentitizers, and the stability of those made by desensitizers to light also give some hints to explain the cause of such a wonderful action of certain colouring matters upon silver bromide grains. The further study of these phenomena of dispersion will surely bring us the key to study the mechanism of sensitivity and also possibly that of latent image of photographic plates.

—(*From Scientific Papers of the Institute of Physical and Chemical Research*, pp. 285-293.)

COSMIC RAYS.

It is known that electrons or charged atoms are deflectable by projecting them across the lines of force of a magnetic field. X-rays and ordinary light as well as Hertz waves are not deflected in this manner by the use of powerful fields.

Whether a beam of light if reflected many times so as to graze repeatedly a highly charged sphere would finally show a deflection or not is perhaps a question.

However this may be, Dr. L. F. Curtis, of the U.S. Bureau of Standards, has succeeded in deflecting cosmic rays, since without the presence of a magnetic field the rays are not deflected from a counter.

This seems to indicate clearly that cosmic rays are corpuscular.

It looks very much as if one end of the spectrum (the cosmic wave-lengths are so short as to place them at the very extreme end of a spectrum series) was a *wave* and the other end a *particle*, as discussed briefly many years ago by the present writer (see *Chemical News*, 1915, *111*, 301-303). Sir William Bragg in some still earlier writings had discussed a similar idea if the present writer remembers it correctly.

It will not do, however, to jump to conclusions. This is merely a passing observation that is not intended to be anything more. The passage of energy through these two extremes is, however, a very interesting topic of discussion and should engage especial interest. Perhaps the idea of the problem being three-cornered is suggested here, in the light of the electron being in some experiments a wave, or "wavicle."

F. H. L.

THE INFLUENCE OF TECHNIQUE ON RESEARCH: BEING THE TWENTIETH MAY LECTURE TO THE INSTITUTE OF METALS, DELIVERED MAY 7, 1930.

By Major F. A. Freeth, O.B.E., D.Sc., Ph.D., F.R.S.

(*Concluded from page 330.*)

The next factor is the people who read what I have written. Once again their own minds produce a barrier between the original work and what they conceive to be the facts. Now I venture to submit to you that this constitutes a potential weakness of the research association, and I would like to suggest, with great respect, that even though the individual members of an industry may not be able to support a research department of their own, yet they should be possessed of a certain minimum of experimental equipment which will enable them to repeat the best of the results which have been obtained by the labours of their research association in order that they may experience the extraordinary benefit of first-hand acquaintance with experimental work, the benefits of which it is almost impossible to overstate.

Whilst I am on this subject I should like to make a digression as to the benefits and dangers of a research association. A research association is usually maintained by a trade or industry, the members of which consider that their individual resources are not sufficiently great to warrant the establishment by them of a first-class research department. They, therefore, pool their means and do the work centrally. Now, admirable as this is, there is a danger; and that danger is best expressed by a consideration of the way in which scientific information is broadcast to the world. Suppose, for example, I carry out a long piece of experimental work, the

results of which are eventually published. On account of the fact that in most scientific societies the funds available for publication are strictly limited, I am bound in honour to describe my results as concisely as possible. I am also consciously or unconsciously influenced by that tremendous temptation to make my results appear as a logical sequence. There are so many discoveries in science which when they are completed appear as logical necessities but when they were being made were anything but this. I am very apt to suppress a number of minor details, failures, and the like. The result is that I give to you, possibly, rather an attractive picture of a piece of research, but which, if I am honest with myself, does not by a long wav express what I really did, went through, and undertook.

As society becomes more and more organized, the more able people are generally forced, even against their will, to become organized themselves and to delegate a very great deal of work. This may be, and probably is, necessary, but it introduces a corresponding element of weakness. We all know that directors of research are very necessary individuals, but if you take the trouble to canvass the opinion of the celebrated men of our time—and I do not see any other way you can do it— you will find that there is a remarkable consensus of opinion that any man, however great his genius, is probably not capable of directing the work of more than fifteen people ; that is to say, of directing the work in order to obtain the maximum results. The result of this is that those men who are most fitted to judge the experimental value of a piece of work very often have not got the opportunity to do so. Taken to its limit, over-organization means that all the work is done by juniors, and you will find a good deal of opinion in support of tbis statement.

The question of what might be done, given existing resources and technique, in the way of immediate discovery is a fascinating one. I am encouraged to attempt a little prophecy by the fact that one of my very distinguished superiors has recently ventured into a fascinating series of speculations as to what will happen a hundred years from now. To-night I am going to venture to predict what might begin to happen in two or three years if you could find anyone with sufficient courage to tackle the problem in earnest. First is the question of a prime mover. During the lifetime of the majority of those whom I am addressing we have seen very great changes taking place in the prime-mover. We have seen the steam-engine advance enormously in efficiency owing to the use of the turbine, which again is threatened by the Diesel engine. I would venture to predict that there is very little except money and courage standing in the way of the immediate development of the gas turbine, and, if there is anything standing in the way, the opposition will come from the metallurgist, who will tell me he is not possessed of the materials capable of standing up to the rigorous conditions which will be required. I would venture to prophesy that in ten years' time we shall see the gas turbine, or something like it, utilizing between 40 and 45 per cent. of the heat efficiency of the fuel in the form of mechanical energy on the shaft and, as this is a general and not a specialized lecture, I should like to recall to the memories of some of you that the efficiency of an engine depends upon the initial and final temperatures of the thermodynamic fluid employed and not essentially upon its pressure. If we can find materials which will stand up to largely increased temperatures—and there are many snch, and new ones are constantly appearing—I can see no valid reason why we should not secure a very greatly increased efficiency in our prime-movers.

Then we have the question of the strength of metals. Everyone knows that a metal is not as strong as it ought to be. Do you not think that it is very probable that within the next ten years you will be possessed of metals and alloys of much greater strength than you have at present, and that this will come about almost entirely by improvements in technique?

The other scientific matter which I have in mind, and which offers not too much technical difficulty, is a question of what would happen if science were possessed of the means of using increased voltages. In this connection one must be very careful not to stimulate exaggerated hopes, but there is no reason at the present time why an installation should not be erected capable of generating an electrical pressure of, say, ten million volts. I think that you will find that, granted such a pressure can be attained, there is every possibility in the minds of thinking men that scientific results of really astonishing character could be obtained.

Now what is the real difficulty in putting such ideas into execution. The difficulty is a financial one. There are many phenomena which require large-scale apparatus, a very great deal of expenditure before

they can be realized. Also they may fail. So I would submit to you there are certain aspects of research which can only be taken up by, say, governments. We all welcome the very generous assistance which the State has afforded to science during the last generation, but I think that it ought to go further. There are certain experiments which can only be carried out with the expenditure of very large sums of money, and the results of which might be so far-reaching that they are very well worth the thoughtful attention of an enlightened government if only on the score of a gamble.

There is one question concerning the influence of technique on research which has occupied the attention of some of the greatest minds in history. I am referring to the technique of discovery itself. Francis Bacon, as you all know, set himself the task of devising a machine, as it were, which would enable mankind to make discoveries and to advance as it had never advanced before. As you all know he failed, but his failure was sufficiently magnificent to remain a monument throughout the ages. I should like to venture to make a few remarks on this subject, not because I feel particularly fitted to do so, but because some kind of comment is better than no comment at all. The question is how are we to make discoveries? To answer it, of course, is impossible, but we can make some approximations. When psychology becomes an exact science it will supply the answer. In the meantime, it is of the greatest interest to examine some of the mainsprings of human endeavour. It is particularly necessary to do so at the present day when the research has become a profession. By way of digression I should like to make some comment on my own reactions as a scientist in this respect. I have gone up and down the country speaking to whoever would listen to me on this subject, and such is the influence of training that I feel the greatest diffidence in saying what I have said in the effect before, which is a tribute to the discipline under which every author of original papers labours, that he must not say what he has said before. The present drift of modern life is undoubtedly against discovery. Some of you will remember that appalling picture of a great research institution which is brilliantly depicted by the American novelist Sinclair Lewis in "Martin Arrowsmith." To-day is inevitably and undoubtedly the day of the administrator, and if you look back on the history of science you will find that its great men have very frequently been poor administrators. How are we to compromise? It is largely a question of stimulus. Every man has a kind of clock-work driving mechanism which forces him through life, and I would submit to you that we have seriously to consider the mainsprings of effort when we deal with modern research. Research is primarily a matter of intellectual interest, therefore its driving force should be mainly intellectual. This demands a peculiarly paradoxical state of mind, almost religious in its aspect.

In dealing with this queston we must consider first of all our own national characteristics. On the whole, Great Britain prides itself on being practical, and there is an intense desire on the part of most people to justify their work and to show that it will eventually produce something which will add to the general good of mankind. This, of course, is entirely admirable, but as the French say, it has the defects of its excellences. It is very difficult to see ourselves in a true perspective, and it is interesting and instructive to see what other people think of us. Price Collier in his book "England and the English," published about twenty years ago, said that the first thing one Englishman asked of another is what has he done. Sympathetic critics in the Latin nations have also noted our intense desire to be doing something. I would submit to you that the way to make discoveries is to stimulate those who are engaged in research in such a manner that above all things they should be allowed to go their own way, if they show any desire to find out what is going on, irrespective of whether it is any use or not as long as it lies somewhere in the right direction. There is a very successful Institute of Industrial Research in this country, the director of which, one of the greatest men of the day practically allows his staff to do what they like, his argument being that general compulsion is sufficiently great to prevent them wandering very far from the main path, and that any reasonable wanderings such as they may undertake will be all to the good. Considerations like this make one wonder if, to take an example, the general organization of industrial research is right in this country. We have associations for the study of various definite industrial problems—you yourselves, for example, in the Institute of Metals. We have institutions for the study of various textiles. It is, I submit, an open question as to whether you would not obtain better results if you organized your research by divisions of science rather than by divisions of practice. Let us take metals, for example. You could bring in metals and

many other things into an institution devoted to the study of high-temperature equilibria, using the word in its widest sense. I think that there is no question but that the mainspring of research should be scientific enthusiasm, and that you should judge a man far more by the quality of his work than by the results it produces. Modern life, especially industrial life, offers such glittering material prizes to the administrator that we must endeavour to find a stimulus for the scientific research worker proper. This stimulus I put to you should be mainly untellectual.

Now let me try to sum up all that I have said.

(1) There is no royal road yet known to discovery and to the attainment of new scientific results, but the history of the past shows us that resnlts have very often been obtained by working in new and difficult fields. To obtain these results is very largely a matter of technique, and the mechanical *aids to the prosecution of scientific research* in this country are not nearly as great as they might easily be.

(2) The vertical organization of modern science and life render this additionally difficult. I am suggesting to you that technique taken more seriously would act as a kind of solvent among the various groups.

(3) We should do everything in our power to stimulate the intellectual interest and enthusiasm of our research workers.

(4) Finally, and by way of an apology for my temerity, I should like to quote to you the magnificent words of Francis Bacon which occur at the end of the first book of the "Advancement of Learning."

"Nevertheless I do not pretend, and I know it will be impossible for me by any pleading of mine, to reverse the judgment, either of Æsop's cock, that preferred the barleycorn before the gem ; or of Midas, that, being chosen judge between Apollo president of the Muses and Pan god of the flocks, judged for plenty ; or of Paris, that judged for beauty and love against wisdom and power; or of Agrippina, let him kill his mother provided that he become emperor, that preferred empire with condition never so detestable ; or of Ulysses, who preferred an old woman to immortality, being a figure of those which prefer custom and habit before all excellency ; or of a number of the like popular judgments. For these things continue as they have been : but so will that also continue whereupon learning hath ever relied, and which faileth not : wisdom is justified of all her children."

GENERAL NOTES

CRITICAL PRESSURE GAUGES.

An Interesting Instrument for Steam. Plant Operation.

By A Well-Known Engineer.

One of the results of the fact that steam generation is now rapidly becoming a specialised branch of engineering is the general recognition that the ordinary type of steam boiler pressure gauge is not sufficiently sensitive as regards accurate control of the firing conditions. That is the steam demand changes to an appreciable extent before any movement is given on the pressnre gauge, or in other words there is a definite "lag" between the indications given as regards steam demand and combustion conditions. Highly interesting therefore is a new design of extremely sensitive "critical" pressure gauge that has now been put on the market by Hopkinson of *Huddersfield, which shows at once, considerably* in advance of the ordinary pressure gauge, whether the pressure is rising or falling, a matter of considerable interest also for chemical engineering in general. This gauge can be fixed in any convenient position on a wall or panel in the boiler house, or suspended from the roof, in which case a "double dial" type is used, with a dial at each side and two separate pointers. These latter are first set by an adjusting knob outside the instrument when at the desired correct pressure, that is under the normal operating conditions to the centre mark. The dial is graduated to any degree, say, 5 lb. above and below the normal, according to the sensitiveness of the reading necessary, the scale being about 18 inches long marked on opal glass illuminated from behind. As a result the boiler house attendants are enabled to have a continuous and immediate indication of the tendency to pressure change, up or down, and can adjust the firing accordingly.

The basic principle of the design is the use of a weight loaded diaphragm, the steam pressure on which is balanced by a series of weighted levers with knife edges, something on the same principle as the platform weighing machine. Any movement in the diaphragm caused by the slightest alteration in the steam pressure is transmitted to a long pointer, the movement of the diaphragm being enormously magnified by the leverage system used. As already indicated this weight balancing the steam pressure can be adjusted with great accuracy by means of a knob or key so that the

pointer is brought to the central mark on the scale under any desired pressure conditions, from which any rise or fall is indicated at once.

GAS-WORKS THAT SUPPLIES MILLIONS OF GALLONS OF TAR.

Special goods trains carrying hundreds of thousands of gallons of tar are this week being despatched to various parts of the country, where the intensive road repair offensive to provide motorists with safe, non-skid surfaces is now beginning.

Owing to the increasing demands of contractors and road surveyors for British tar, more than 200 men are now engaged in its production and despatch at one of the world's largest depots, sitnated at Ordnance Wharf, Tunnel Avenue, East Greenwich.

At this depot, whch is maintained by the South Metropolitan Gas Company, many thousands of gallons of tar, which have been accumulated dnring the winter months in a huge black lake many feet deep, are held in reserve.

In the eleven tar stills of the Company, to which by-products obtained during the production of gas for South London homes are brought, more than 25,000 gallons of high qnality tar are daily produced. For the next three months, in addition to the despatch of tar by rail and motor lorries, specially-constrncted steamers will be calling regularly at the Thames-side jetties for supplies for Continental countries, where, as in England, experts are now realising the value of tar for road surfaces.

Adjoining the South Metropolitan Gas Company wharves is a barrel store. Before being filled with tar, these barrels are brought down to the coopering sheds, where after being overhauled and fitted with new steel bands, they are thoroughly " bathed " in rotary soda baths, fitted with huge scrubbing brushes.

A few days later, when properly dry and cleaned, the barrels are fiilled with a high-grade and careful refined metro tar. They are then sealed and stamped and are passed out to be despatched to the county road sides, where they may be seen by motorists, awaiting the arrival of the road gangs.

It is interesting to note that, owing to the healthy nature of the work, more than 10 per cent. of the employees engaged in this strenuous task are men of over 60 years of age.

CHEMICAL MANURES FOR EGYPT.

The Commercial Secretary to the Residency, Egypt, reports that the Egyptian Ministry of Agriculture is calling for tenders, to be presented in Cairo by the 7th June, 1930, for the supply of :—

Tons gross.	
48,000	Ordinary Nitrate of Soda.
48,000	Granulated Nitrate of Soda.
12,000	Nitrate of Lime.
7,000	Superphosphate of Lime.

Firms desirous of tendering can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35 Old Queen Street, London, S.W.1. Reference number B.X. 6422 should be quoted.

LEAD PRODUCTION IN CANADA.

Lead is derived from mines in the Ynkon, British Columbia, Ontario and Quebec but 95 per cent. of the Dominion output is obtained from British Columbia. In this province the Sullivan, the world's largest silver-lead-zinc mine, sends a steady stream of concentrates to the great smelter at Trail where pig lead is produced and other valuable products are recovered. Some other sonrces of lead are the Treadwell Yukon mine near Mayo, Yukon Territory, the King don mine at Galetta, Ontario, and the Tetreault property at Notre-Dame des Anges, Quebec.

World production of lead in 1929 is estimated at 1,930,000 short tons, a new high record for all time. Beter prices which prevailed for the most part of 1929 brought out more lead. In contrast to this Canada's lead production showed a slight decline from the output in 1928 but, due to higher prices, the aggregate output of lead from Canadian ores was attained in 1928 while the greatest value reported was for 1925 when prices of lead were very much higher than at present.

The following table relative to lead production in Canada, 1929, has just been issued by the Dominion Bureau of Statistics at Ottawa :—

	Pounds	Value $
Quebec	5,358,304	270,594
Ontario	4,715,789	291,717
British Columbia	307,290,605	15,518,176
Yukon	8,585,547	433,570
Total	*325,950,245*	*$16,514,057*

Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The Annual Meeting will be held at Bristol September 3-10, 1930.

The Presidential Address by Prof. F. O. Bower, will deal with "Size and Form in Plants."

Among the principal subjects expected to be dealt with in Sectional Addresses and Discussions are the following :—

State Experiment in Chemical Research. The Taxonomic Outlook in Zoology. Evolution in Material Culture (Anthropology). The synthetic Activities of the cell. Recent Developments and Present-day Problems in Taxonomic and Economic Botany. A Proposed National Folk-Museum. A policy of Higher Education. The Scope and Aim of Human Geography. Mineral elements in Plant Nutrition. The Foundations of Child Psychology. Air Pressure Variations in Engineering works and their Physiological Effects. Rationalisation and Technological Unemployment. In what sense can we speak of Primary Colours? The Relation between post-Pluvial and Glacial Periods.

The Sections will be in Session severally or jointly throughout the Meeting for the hearing of papers on many other subjects within their various departments.

Evening discourses will be given by Prof. E. V. Appleton, F.R.S., on 'Wireless Echoes,' and by Dr. R. E. Slade on 'The Nitrogen Industry and our Food Supply.'

Evening Receptions, and Excursions to points of scientific interest, works, &c., in the locality, will be arranged. Provision for the accommodation of visiting Members &c., is in the hands of a Local Committee.

THE PHYSICAL SOCIETY.

VISIT TO RUGBY, JUNE 14, 1930.

The following programme has been arranged provisionally :

Leave Euston 8.30 a.m.; arrive Rugby 10.7 a.m. On arrival at Rugby the party will walk to the works of the *British Thomson-Houston Company, Ltd.*, which adjoin the railway station, and a general tour of the works will be proceeded with under the direction of guides. Lunch will be provided by the above Company in the Staff Restaurant at 12 noon.

Particulars of the Assistant Secretary, 1, Lowther Gardens, London, S. W. 7.

THE FARADAY SOCIETY.

Wednesday, June 4, at 5.30 p.m., at King's College (University of London), Strand. — Ordinary Meeting. Papers on Analysis by X-rays will be read as follows :

"Quantitative and Qualitative Analysis by X-rays." By Professor T. H. Laby.

"The Determination of Potassium in Soil Samples by the Application of an X-ray Method." By J. T. Calvert.

The papers will be available in print by the morning of the Meeting. As to Paper 1, reference may be had to *Nature*, 5 April, 1930, page 524.

The meeting is intended to give Professor Laby the opportunity of discussing the technique of his method with physicists and metallurgists as well as with others interested in the subject.

THE PHYSICAL AND OPTICAL SOCIETIES.

JOINT DISCUSSION ON PHOTO-ELECTRIC CELLS.

A discussion on "Photo-Electric Cells, their History, Development, and Manufacture, and their Varied Applications," will be held at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7., on Wednesday and Thursday, 4 and 5 June, 1930.

The Discussion will be open to the public. Members are specially invited to make the meeting widely known among their friends.

ACHEMA EXHIBITION.

In June next (10th to 24th inclusive) the *sixth Achema Exhibition will be held at* Frankfurt and it is expected to be the largest exhibition of chemical apparatus ever planned.

MINERALOGICAL SOCIETY.

Tuesday, June 3, at 5.30 p.m.—General Meeting. The following papers will be read :

"On a New Meteoric Iron from Piedade do Bagre, Minas Geraes, Brazil." By Dr. L. J. Spencer.

"Notes on British Barytes." By Miss Jessie M. Sweet.

"On Face- and Zone-Symbols referred to Hexagonal Axes." Mr. M. H. Hey.

"Biographical Notices of Mineralogists recently Deceased (Fourth Series)." By Dr. L. J. Spencer.

"On a Tholeiitic Phase of the Quartz-Dolerite Magma of Central Scotland." By Dr. F. Walker.

"On Pink Epsomites and Fauserite." By Mr. M. H. Hey.

ROYAL INSTITUTION.

21, Albemarle Street, London, W.1.

Monday, June 2, at 5 p.m.—General Meeting.

Proceedings and Notices of Societies

GEOLOGICAL SOCIETY OF LONDON.

April 30th 1930.

R. S. Herries, M.A., Vice-President, in the Chair.

The following communications were read :—

1. 'Some Non-Marine Lamellibranchs from the Upper Part of the Coal Measures.' By Emily Dix, M.Sc., F.G.S., and Arthur Elijah Trueman, D.Sc., F.G.S.

This paper deals with the non-marine shells which occur in the upper part of the Coal Measures, namely, in the higher part of the *Pulcra Zone* and in the *Phillipsi* and *Tenuis* Zones. Recent studies of Carboniferous non-marine shells have been chiefly concerned with the Lamellibranchs which occur below these horizons Nearly all the shells found in these higher measures are members of the genus *Anthracomya*, and most of them are related to the group of *A. phillipsi*; but there is evidence that another group, represented by shells which resemble A. laceolata Hind, occurs more rarely at widely separated horizons.

The holotype of *Anthracomya phillipsi* (now in the Manchester Museum) is figured and re-described, and the variations of this species which occur at different horizons in the *Phillipsi* and *Tenuis* Zones are discussed. The small shells from the base of the Newcastle-under-Lyme Group of North Staffordshire, described by Wheelton Hind as *A. calcifera*, have been re-examined ; it is shown that they are associated with larger crushed shells (of the group of *A phillipsi*), and it is suggested that *A. calcifera* represents a dwarfed form of this group, in which the adult characters are attained at a small size. The shells are distinct from those which occur in the Assise le Riveo-de Gier and which have been referred *A. Calcifera* by Prof. P. Pruvost.

It is shown that a distinctive series of *Anthracomya*, including *A. adamsi* Hind *non* Salter, *A. dolabrata* Hind, and several new forms, occurs near the middle of the *Pulchra* Zino in South Wales, North Staffordshire, and Yorkshire; in each area the horizon overlies a well-marked marine bed (the Gin mine of North Staffordshire and the Mansfield Bed of Yorkshire).

Another characteristic horizon is found near the top of the *Pulchra* Zone, the shells consisting almost entirely of small forms regarded as related to *Naiadites elongata* Hind. The distinction of these and other small forms from small examples of *Anthracomya phillipsi*, especially in crushed specimens, is dealt with, in relation to the range of *A. phillipsi* and its allies.

The variants of *A. phillipsi* characteristic of the *Phillipsi* Zone can be recognized in almost every British coalfield. Where it is present the suceeding *Tenuis* Zone can also be readily distinguished. Although several horizons within these zones appear to be characterized by distinctive forms, the Authors are unable to suggest any further subdivision of the zones.

It is shown that, in several respects, the sequences determined in many British coalfields are remarkably similar and reasons are advanced for the view that at certain periods in the late Carboniferous Period there was considerable uniformity in the conditions over large parts of Britain. It is also indicated that there are great similarities in the sequence in the upper part of the Westphalian of the Continent.

2. The Flora of the Upper Portion of the Coal Measures of North Staffordshire.' By Emily Dix, M.Sc., F.G.S.

The paper deals with the distribution of fossil plants in the Upper Coal Measures of North Staffordshire above the horizon of the Ash Coal.

Various views have been put forward concerning the classification of these measures, but the classification which is generally used was suggested by Dr. Walcot Gibson in 1901, who placed the base of the Upper Coal Measures at the Bassey Mine Ironstone. He further divided the Upper Coal Measures into the Black Band Group, the Etruria Marl Group, the Newcastle-under-Lyme Group, and the Keele Group. Kidston in 1905 suggested that the Keele Group represented the true Upper Coal Measures, which he called the 'Radstockian Series'; the remaining three groups he placed in the Transition Coal Measures or Staffordian Series.

The late Dr. Wheelton Hind in 1905 criticized the introduction of these new terms, and said that there was no good reason for taking the Bassey Mine Ironstone as the base of a subdivision, because a similar fauna and flora occurred both above and below that horizon.

Few plants have hitherto been recorded from the measures for some distance below the Bassey Mine Ironstone and the chief

purpose of this paper is to give an account of these measures with the view of determining the horizon which marks the entrance of the Staffordian flora in North Staffordshire.

A considerable number of new records are given, and from these records it is clear that the measures for some hundreds of feet below the Bassey Mine Ironstone yield a flora in which Radstockian and Yorkian species are mingled, and therefore it is concluded that the base of the Staffordian should be drawn below the Chalky Mine Ironstone, about 400 feet below the Bassey Mine Ironstone.

This conclusion is of importance in the correlation of such areas as South Wales, Staffordshire, and Somerset by means of fossil plants. In South Wales it has been shown that the base of the Staffordian can be drawn at the horizon of the No. 3 Rhondda Seam, which is near the base of the *Phillipsi* Zone. The base of the *Phillipsi* Zone in Staffordshire has been placed at the Lady Coal, and it had thus appeared that the base of the *Phillipsi* Zone and the base of the Staffordian are not in such close proximity as in South Wales. The conclusions reached in this paper, however, establish the similarity in the succession at these horizons in the two areas.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

30, Russell Square, London, W.C.1.

APRIL EXAMINATIONS, 1930.—PASS LIST.

Examination in General Chemistry for the Associateship:

Adams, Harold, A.M.C.T. (College of Technology, Manchester); Allen, Frederick William, A.M.C.T. (College of Technology, Manchester); Beese, Dennis Clifford (Sir John Cass Technical Institute, London); Bush, Frederick William, B.Sc. (London) (Battersea Polytechnic, London); Churchouse, Archibald Henry, B.Sc. (London). Crawford, Robert Craig (Royal Technical College, Glasgow); Dembrey, Ivor, B.Sc. (Bris.) (The University, Bristol); Fenner, Joseph (Central Technical School, Liverpool); Hale, Ernest Edward (West Ham Municipal College, London); Joseph, James Dillwyn, A.M.C.T. (College of Technology, Manchester); Maddocks, John Robert, A.M.C.T. (College of Technology, Manchester); Nicholson, John, B.Sc (Lond.) (West Ham Municipal College, London); Owen, Arthur Ernest, B.Sc. (Lond.) (Central Technical School, Liverpool); Pass, Alfred (Technical College, Birmingham; and Sir John Cass Technical Institute, London); Peek, William Caird (Royal Technical College, Glasgow); Rawlings, Ernest Emerson, B.Sc. (Lond.) (Municipal Technical College, Hull); Steer, Edwin Hemus, B.Sc. (Lond.) (Technical College, Birmingham); Thomas, Richard Spenser (The University, Manchester, and Technical College, Birmingham); Westhead, James, A.M.C.T. (College of Technology, Manchester); Wilks, Alfred Leonard, B.Sc. (Lond.).

Examination for the Fellowship:

In Branch C: Organic Chemistry:

Harding, George; Reid, Eric; Smith, Dudley Herbert, M.Sc. (Lond.), A.R.C.S., D.I.C.

In Branch E: The Chemistry, including Microscopy, of Food and Drugs, and of Water:

Balmforth, Leonard, B.Sc. (Lond.); Coysh, Reginald Henry, M.Sc. (Bris.); Hallas, Charles Arthur, B.Sc. (Lond.); Herd, Magnus, B.Sc. (Glas.), A.R.T.C.; Jamieson, Archibald Robert, B.Sc. (Glas.); Messenger, Walter George, B.Sc. (Birm.); Roche, James, William, B.Sc. (Bris.); Rooke, Horace Samuel, M.Sc. (Birm.); Stevenson, Samuel Gordon, B.Sc., B.Pharm. (Lond.); Stothart, Sydney Norman Herbert, Ph.D. (Liv.).

In Branch G: Industrial Chemistry:

Bell, James Horst Brunneman, M.A., B.Sc. (Edin.); Revis, Frank Leonard Bingham, A.C.G.F.C.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

13,915.—I. G. Farbenindustrie Akt.-Ges. —Purification of sulphuric acid. May 6.

13,955.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of reduction products of anthanthrones. May 6.

14,390.—I. G. Farbenindustrie Akt.-Ges. Manufacture of vat dyestuffs. May 9.

14,454.—I. G. Farbenindustrie Akt.-Ges. Production of alrehydes, etc. May 10.

14,483.—I. G. Farbenindustrie Akt.-Ges. Manufacture of hydroxydiphenylindole derivatives. May 10.

Specifications Published.

328,635.—I. G. Farbenindustrie Akt.-Ges. —Method of supplying heat required for effecting chemical reactions.

303,375.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of products of the anthracene series.

305,174.—I. G. Farbenindustric Akt.-Ges. —Process for the manufacture of monoazo dyestuffs.

306,450.—Deutsche Gold- und Silber-Scheideanstalt Vorm. Roessler.—PreparingN-substituted cyanoformarylides.

311,231.—Kaufmann, H. P. — Preparing compounds of alkaline earth nitrites with methyl xanthines.

Abstract Published.

326,977—Nitric acid-alkali bisulphate.—I. G. Farbenindustrie Akt.-Ges.; Frankfort-on-Main, Germany.

Sulphuric acid is separated from aqueous solutions containing nitric and sulphuric acids, such as those obtained in the reaction of dilute nitre acid upon alkali metal sulphate to yield alkali metal nitrate and sulphuric acid, by adding alkali metal sulphate or nitrate to form alkali metal bisulphate, which crystallises out, especially on cooling. To prevent simultaneous separation of alkali metal nitrate, the solution of acids may first be concentrated by evaporation.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official *Trade Marks Journal*, and is Published by permission of the Controller of His Majesty's Stationery Office.

COSTOPOL.

511,863.—A chemical substance for use in the manufacture of textile fabrics in bleaching, mercerising and finishing.—The Firm trading as Wyndham West & Co., Falcon Works, Poland Street, Manchester. May 14th.

NIVOSAL.

504,297.—Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives, but not including salts for making nickel solutions, and not including any goods of a like kind to these excluded goods.—I. G. Farbenindustrie Aktiengesellschaft, 28, Mainzer Landstrasse, Frankfurt-on-Main, Germany. May 14th. (Associated).

PYRETHICIDE.

511,736.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—The Strawson Chemical Co., Ltd., 79, Queen Victoria Street, London, E.C.4. May 14th. (Associated).

507,718.—A label device and the letters I.C.I. and a scroll. Chemical substances used for agricultural, horticultural, veterinary, and sanitary purposes. — Imperial Chemical Industries, Ltd., Imperial Chemical House, Millbank, London, S.W.1. May 14th. (Associated).

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OTICE TO AUTHORS & CORRESPONDENTS.

Contributions for publication either as riginal articles or in the correspondence olumns are welcomed by the Editor of *'he Chemical News.*

They must be accompanied by the conributors' full names and addresses, not ecessarily for publication, but as an idication of good faith. If a reply is eeded or if it is desired that a manuscript 'hich is not accepted for publication be eturned, a stamped addressed envelope hould be enclosed.

No notice can be taken of anonymous tters.

VELOCITY OF LIGHT.

By F. H. LORING.

Professor A. A. Michelson's monumental work in determining the velocity of light with a high degree of accuracy is too well known to require any other statement here than that its value is 2.99796×10^{10} cms. per second in a vacuum. See *Astrophysical Journal*, 1927, *65*, 1; see also Birge's discussion of Michelson's value and also this value as a ratio (see below) in the *Physical Review Supplement*, 1929, *1*, particular pages 8 to 10.

In the *Chemical News*, 1930, *140*, 242-244, some numerical relationships were given by the present writer involving certain equations, particularly,

$$c = R_\infty / \{4! \times (1+2+3+4)^{-33} / h\}$$

$= 29979640858$ cms. per second, when

$h = 6.55\dot{6} \times 10^{-27}$ and

$R_\infty = 109737.\dot{3}\dot{7}$.

In the same Journal, 1930, *140*, 210-212, some further relations were shown, particularly that—

1
2
4
8
16
32
64
128 etc.

124999 . . . $\times 24 = 29999$ . . .

The numbers 1, 2, 3, 4 when multiplied together give $24 (= 4!)$. Their sum is 10.

We know that the area of a circle is $(2r)^2 \times 0.785398163$ . . . , where r is the radius of the said circle.

Now Sir A. S. Eddington's value, 137 exactly, is derivable from the well-known equation

$hc / 2\pi e^2 = 137$ (see *Proc. Roy. Soc.*, 1930, *A 126*, 696-728).

Keeping to the above values for h and c the value of e is $4.77864257 \times 10^{-10}$.

Incidentally, these values give $e/m = 17692766$ through the known equation

$$R_\infty = 2\pi^2 e^5 / h^3 c^2 (e/m),$$

R_∞ also being as given above. This was previously shown (*loc. cit.*).

Now $137 + 24 = 161$. Let this be $2r$; then the area of the circle of this diameter is $\frac{1}{4}\pi 161^2 = 20358.3058$.

From these values the velocity of light, c, can apparently be evaluated with accuracy thus :—

$3 \times 10^7 - \frac{1}{4}\pi(137+24)^2 = 29979641.694$, which

is c *in kilometres* $\times 100$, *or* c *in* km. $\times (1+2+3+4)^2$—see above.

The two values of c as per these numerical relations may be compared thus :—

29979641694
29979640853

841 Diff.

These values of c can be made to agree exactly by slightly adjusting R_∞ in the decimal region. It would then be 109737.376815 . . .

It is to be noted that the best experimentally derived value of R_∞ (Houston's value endorsed by Birge) is 109737.42 ± 0.06, so that the above value for this quantity appears to be within the experimental error. The above value for e/m agrees closely with Wolf's deflection value corrected, *viz.*, 1.7689×10^7 (see Birge, *loc. cit.*).

Commenting on these numerical results or methods, in themselves they are of doubtful value, but it is possible that if the values be strongly supported experimentally the methods will lead to some physico-mathematical interpretation, at any rate *they seem worth recording.*

It must be remembered that c is also a *ratio—that of the electrostatic to the* electro-magnetic units.

It is to be noted that recurring decimals represent geometrical progression, so that through these relations there is a certain curious and suggestive correspondence or harmony, but it is possible that this is partly coincidence, yet it seems impossible that it is *all* of this nature. We await with interest Michelson's new determination of c, which is in progress.

AN IMPROVED METHOD FOR PREPARING VISCOSE .

By I. J. Frenkel.

During the spinning of viscose silk an abundant development of gas injurious to health is observed; sulphuretted hydrogen, carbon bisulphide and the formation of sulphnr dioxide, as well as a particularly nasty smell may be observed .

The introducing into viscose of sodium nitrite (0.3-0.4 per cent.) of the weight of the viscose lowers the development of noxious gases to a minimum and entirely kills the nasty smell. The nitrous acid formed during spinning at the limit of contact of the viscose solution with the sulphuric acid of the reducing bath acts catalytically on the sulphuretted hydrogen and carbon bisulphide formed. The reactions of the oxidising action of nitrous acid on sulphuretted hydrogeu and carbon bisulphide may be formulated as follows :

$2OH.NO+H_2S=S+2NO+2H_2O$;
$NO+O=NO_2$; $NO_2+H_2S=S+NO+H_2O$
$2OH.NO+CS_2=COS+H_2S+N_2O_3$;
$COS+S+2NO+H_2O$
$2OH.NO+COS=CO_2+H_2S+N_2O_3$;
$4OH.NO+CS_2=CO_2+2S+4NO+2H_2O$
$6OH.NO+H_2S+CS_2=3S+CO_2+6NO+4H_2O$

The catalytical oxidation of sulphuretted hydrogen into sulphur by means of nitrous acid may be compared in this case with the preparation of nitrous acid by the chamber process, where the oxides of nitrogen taken in a very small amount, transfer large amounts of sulphur dioxide into anhydrous sulphur.

As a proof of the fact that the adding of nitrite to viscose really greatly diminishes the development of sulphuretted hydrogen and carbon bisulphide during spinning may serve the examples of quantitative experimentation in the laboratory and in the factory of the gases developing when viscose is decomposed by acid.

Analysis of viscose of one and the same maturity without and with nitrite produced on the average the following results :

20 gr. of viscose without nitrite by Bernhardt's method (decomposition by normal sulphuric acid and distillation of sulphuretted hydrogen and carbon bisulphide) showed 0.1 gr. H_2S and 0.36 gr. CS_2, which corresponds in per cents. to 0.5 per cent. H_2S and 1.8 per cent CS_2. The *same amount* of viscose with 0.3 per cent. nitrite produced 0.0058 gr. H_2S and 0.12 gr. CS_2, or in per cents. 0.03 per cent. H_2S and 0.6 per cent. CS_2.

Air analysis in the boxes of the exhaust conduit (canalisation) in the spinning department of the factory according to the expert commission's official report from July 16th, 1928, gave the following results :

	Sulphuretted hydrogen	Carbon bisulphide	Sulphur dioxide
During work with nitrite in mgr./litre ...	0.03	0.37	0.046
During work without nitrite	0.24	1.08	0.34

The application of nitrite at the "Viscosa" factory in "Mutisschi" resulted in a marked bettering of the injurious air of the spinning department, of the factory premises and of the whole surrounding locality. According to factory data, from the beginning of the nitrite application, eye diseases among the workmen declined 80 per cent., and later, eye diseases nearly ceased; single cases only were observed.

In January, 1928, during work without nitrite 80 cases of eye diseases were observed at the "Viscosa" factory. In working with nitrite, from 31/I to 15/II, 1928—12 cases; without nitrite, from 15/II to 25/II, 1928—48 cases; with nitrite, from 27/II, 1928, to 27/III, 1928—21 cases. According to data in foreign literature at the factories abroad, notwithstanding perfected ventilating systems existing there, eye diseases of workers are still observed. It must be here observed that a considerable decrease of sulphuretted hydrogen at the time of the fibre's formation undoubtedly favours the production of a more uniform and strong fibre. It might seem that as much as viscose contains sodium nitrite, during spinning in the reducing bath the accumulation of nitric acid would take place. But, as a matter of fact, by a careful analysis of the reducing bath and of the air the latter has not been made manifest. In reality nitrous acid, being formed in an insignificant amount during its catalytic oxidising action, is mostly reduced to nitrogen and, partially, in a very small amount, to hydrazine, accumulating in the bath in the form of a constant combination of sulphate of hydrazine ($NH_2.NH_2.H_2SO_4$). In one litre of the bath 0.19 gr. of hydrazine was found. Its formation was verified by means of a reagent "benzaldehyde," and by the melting point for benzalazine (93°C.) obtained from condensation of hydrazine with benzaldehyde.

With some sulphate of iron present in the reducing bath at the same time a double sulphate of iron with hydrazine sulphate is also formed, and which separates a brownish-red precipitate mixed with sulphur and iron salts. This brownish-red precipitate is partially carried away by the fibre during spinning and imparts to the threads a brown tint, which disappears during the desulphation of the silk.

The formation of hydrazine and of the double salt of hydrazine may be expressed in the following way:

I.—$2OHNO+H_2S=S+2NO+2H_2O$

$2NO+H_2S=N_2O+S+H_2O$

$H_2S+H_2SO_4=S+H_2SO_3+H_2O$

$N_2O+3H_2SO_3+2H_2O=NH_2NH_2H_2SO_3+2H_2SO_4$

II.—$2(N_2H_4)2H_2SO_4+2FeSO_4+2H_2S+2OHNO+H_2SO_4=FeSO_4(N_2H_5)_2SO_4+FeS+S+2NO+3H_2SO_4+2H_2O$

For defining the degree of maturity of viscose, Cross's method with decinormal iodine is in this case of no use and, therefore for viscose with nitrite a method of coagulation with ammonium chloride is recommended, according to Hottenroth or the method of defining the contents of carbon bisulphide in the xanthogenate of cellulose.

It is further also necessary to note that the presence of sodium nitrite in viscose does not accelerate the maturing of viscose, as proof of which it may be stated that two like solntions of viscose with nitrite and without the latter (2.5 gr. viscose to 800 cc. of water)—when 10 cc. of normal acetic acid is added—use up the same amount of decinormal iodine, whereas a marked difference is shown by the state of viscose with and without nitrite in a much diluted sulphate medium in the sense of stability of the solution.

If a solution of ordinary viscose (2.5 gr. to 800 cc. of water) is prepared and 25 cc. of normal sulphuric acid is further added to it, then in a minute or two the xanthogenate is destroyed; the cellulose separates in the form of flakes and smells of carbon bisulphide. In a similar solution of viscose containing 0.3 per cent. of sodium nitrite, this phenomenon of xanthogenate destruction is not observed; the cellulose does not separate out, the solution keep constant for a rather long period of time (whole days) and does not smell of carbon bisulphide. Xanthogenate is stable when the content of sodium nitrite in viscose amounts to 0.3-0.4 per cent. However, when the amount of nitrite in viscose is 0.8 per cent., this phenomenon of stability of xanthogenate is not observed. We can, therefore, draw the conclusion, that the content of nitrite in viscose in a determined small amount has a special influence on the colloidal state of viscose. Experience has shown that, notwithstanding the fact that kinetics of the maturing of viscose with or without nitrite are alike, still viscose with nitrite does not demand such a slow holding up, as the usual viscose, and may be released for spinning after 48 hours' of maturing. This, as has been shown by work at the factory, has

brought no deterioration of the silk's quality.

Finally, we must emphasise that the application of nitrite in the viscose production of silk, films, etc., allows a considerable improvement of hygienic working conditions, and thereby heightens the general productivity of labour and also produces a considerable economy in the expenditure for ventilation in the spinning department.

Moscow, U.S.S.R.

MODERN SUPERHEATED STEAM PRACTICE.

An Interesting Paper.

By A Well-Known Engineer.

During the past few years great strides have been made in superheated steam practice, especially for steam and power generation and the latest developments in this connection were described in a paper entitled "Superheating," read some time ago by F. Onions before the Junior Institution of Engineers.

The author gave a complete survey of the subject and dealt for example with the thermodynamic considerations of superheated steam, especially in relation to industry, the superheated steam, especially in relation to industry, the temperature and pressure distribution in turbines, and different methods of fitting superheaters according to the type of boilers. Reference was also made to radiant heat superheaters, combined radiant heat and convection superheaters, independently-fired superheaters, marine and locomotive superheaters, and multiple valve regulator for locomotives, the "Schmidt" high pressure steam locomotive, and power station and industrial plants with high pressure and superheated steam temperatures at 750-1,000° F.

Certainly one of the outstanding impression of the paper is that to obtain the best results with superheating, alike for industrial and power station practice, it is necessary to make a proper study of all the factors involved. Thus an efficient design of superheater, with high heat transmission efficiency and no liability to breakdown, must be based upon considerations of load, steam pressure and temperature, the method of firing the boilers, the characteristics of the fuel, and the type of furnace setting.

The author of the paper is connected with the Superheater Co. Ltd. of London, and the essential features of the firm's "M.L.S." design are the use of the single-pass, as opposed to the multi-pass, principle, and the method of manufacturing the long multiple loop elements. The latter may be of an length required, the tubing being united b means of a special machine forging proces no screwed, oxy-acetylene, or electricall welded joints being used. As a result these methads of design and constructio the permissible limit of temperature that ca be safely employed with low carbon steel now about 850° F., and a considerable nun ber of "M.L.S." installations are operatin or in course of construction, in Great Britai and elsewhere for high pressures and tempe ature conditions of 750-850° F., the old ide that 725-750° F. representing the maximu for low carbon steel being now obsolete.

For industry generally superheating ha two advantages—increased power genera tion efficiency in the engines or turbines wit a moderate amount of superheat, such temperatures of 450-500° F. in the case ' Lancashire " boilers especially in chemic works and reduction of condensation loss in the steam pipe circuits, for which purpo partial superheating only may be used necessary so as to dry the steam tharaughl

The paper also reminds us that for a temperatures conditions the superheat has to withstand more severe conditions tha any other portion of the boiler plant, so th the value of high grade designs and worl manship, as well as extensive experienc does not require emphasis.

SIR ARTHUR KEITH'S THEORY ON "GARDARENE MAN."

On May 5th at the Royal College Surgeons, Sir Arthur Keith discussed t discovery of "Gardarene man" in Gree land, announced by Dr. F. C. C. Hanse Professor of Anatomy in the University Copenhagen.

Sir Arthur Keith said that recently Pr fessor Hansen received from Greenland son human bones from a twelfth-century grav yard attached to the cathedral of Gard (Igaliko) in South-West Greenland. Amo the bones of Norsmen (Viking) was a low human jaw and a large part of a hum skull manifesting characters more primiti and more massive than even those of t Rhodesian fossil skull. These bones we not fossilized but in the same condition those of the twelfth-century Norsemen.

There was a possibility that a belated re resentative of fossil man, okapi-like, mig have survived in Greenland until Nor times, and the lecturer wrote to Profess Hansen, who had sent him drawings a photographs and a full description. Th

they represented an extraordinary and undescribed type of man there could not have been a doubt. The lower jaw was more massive than had ever been found in a human face, yet regularly formed and of enormous strength. That part of the base of the skull to which the neck was attached had expanded into great plate-like butteresses of bone. The hinder (occipital) part of the skull was sharply bent, as in the Java skull, the newly-discovered Pekin skull, and the Rhodesian skull. The temporal muscles of mastication had expanded upwards on to the top of the top of the head until they almost met, as in the gorilla. Although the forehead had been partly lost, it was clear that it was low and receding and that the skull must have been of enormous length—at least an inch longer than the longest fossil human skull. But like early fossil skulls it was very low in the roof. The face was 2in. longer than the face of the average Norseman. The walls of the skull were not unduly thickened, but certain appearances of the bone suggested that growth was not quite normal.

To this old but undescribed and hitherto unrecognized type of humanity, Professor Hansen had given the name *Homo gardarensis*. The problem anatomists had to solve was : How did *Homo gardarensis* come to be buried in an early Christian Norse graveyard in Greenland? Professor Hansen would have nothing to do with the okapi theory. There was no trace of Eskimo in Gardarene man. Certain of the graves contained bones of big-headed very muscular men. Professor Hansen thought that in an isolated Norse colony where families of exceptional strength of body had been segregated, there had been a degree of inbreeding which called forth in some child the latent inheritance antiquity. That *Homo gardarensis* might be looked upon as an atavism—the reproduction of a type of man long since extinct.

Twenty years ago the lecturer became interested in acromegaly, a disorder of growth due to a disease of the organs of eternal secretion. The skulls of men who suffered from acromegaly assumed, in a bizarre form, all the characteristics of the skulls of ancient fossil man, particularly the Neanderthal and Rhodesian characters. Giants, however, particularly in the first stage of this disorder, assumed the cranial characters in a much more regular way. All parts of the jaws, face, and skull might proceed to a harmonious excess of growth. Certainly the specimens described by Professor Hansen exceeded in size and regularity the giant specimens in the College of Surgeons, but they were manifestations of excessive growth of the same kind. *Homo gardarensis* must have been the subject of a disorder of growth the kind of disorder which caused giantism in man, but whereas in most giants growth soon became irregular, in *Homo gardarensis* it remained regular. When we had classified this strange descendant of a Viking with giants we had not explained all. The growth mechanism which was in each of us was a heritage from fossil man. It was, therefore, quite possible, as Professor Hansen maintained, that *Homo gardarensis*, although not found in a fossil state, might reproduce a stage of man's evolution which might yet be actually discovered in a fossil state.

GENERAL NOTES

BRITISH INDUSTRIES FAIR.

The President of the Board of Trade has appointed Alderman E. B. Lewis, J.P., President of the National Chamber of Trade, as an additional member of the Committee recently set up under the chairmanship of Lord Chelmsford, to examine the present situation as regards the British Industries Fair, and to consider what means can be adopted to increase still further its utility to British trade.

DYESTUFFS (IMPORT REGULATION) ACT, 1920.

APPLICATION FOR LICENCES, APRIL, 1930.

The total number of applications received during the month was 688, of which 588 were from merchants or importers. To these should be added 11 cases outstanding on the 31st March, 1930, making a total for the month of 699. These were dealt with as follows :—

Granted—651 (of which 633 were dealt with within 7 days of receipt).

Referred to British Makers of similar products—33 (of which 28 were dealt with within 7 days of receipt).

Outstanding on 30th April—15.

Of the total of 699 applications received, 661 or 95 per cent were dealt with within 7 days of receipt.

CABLE AND WIRELESS RATES.

Saving to cable telegraph users to the approximate amount of £85,000 per annum are the results of reductions in cable and wireless telegraph rates effected by Imperial and International Communications Limited.

Ever since its inception in April 1928 as a joint cable and wireless organisation, incorporating all the British privately owned overseas telegraph services operated by Great Britain, the Communications Company, has had the telegraph charges of the two branches of its services under constant review and has been able to effect revisions and reductions in charges between many centres in various parts of the world to the benefit of users. In some instances these charges have been reduced by as much as 50 per cent.

THE HISTORY OF ANÆSTHETICS.

A commemoration meeting of the Centenary of Henry Hill Hickman, pioneer in anæsthesia, was held by the Royal Society of Medicine, Section of Anæsthetics, at The Wellcome Historical Medical Museum, 54, Wigmore Street, London, on April 2, Dr. Apperley being in the chair. Lord Dawson of Penn, Physician-in-Ordinary to H.M. King George, President of the Royal Society of Medicine, delivered the address.

Lord Dawson's Address.

"It is fitting that a meeting of this Section, having for its purpose the praise of famous men and the appraisement of their deeds, should take place in The Wellcome Historical Medical Museum. Our distinguished Honorary Fellow, Dr. Wellcome, places in full measure running over not only his resources but his thoughts and his actions and his constant encouragement at the service of medicine.

"Far back in the beginnings of history there existed the desire and effort to find relief from pain and suffering. These sedative and even pleasurable effects were produced by such drugs as opium, hyoscyamus, mulberry, hemlock, henbane, and notably mandragora, which appeared to have been allied to mandrake.

In the latter part of the eighteenth century pain seemed to be accepted as an inevitable accompaniment of surgical practice, and this same apathy in the early part of the nineteenth century delayed for years the discovery of inhalation anæsthesia being made available to mankind.

"The discovery of nitrous oxide by Priestley, about 1774, was followed in the year 1800 by the further and important discovery of its anæsthetic properties by Humphry Davy.

Humphry Davy, once an apprentice to an apothecary in Cornwall, was fired to the study of chemistry at the age of 19 by the writings of Lavoisier. A year later, *i.e.*, 1798, he was appointed assistant to Dr. Beddoes, who had an institute at Clifton for treating various diseases, especially phthisis, by inhalation of gases. The same year found Davy experimenting with nitrous oxide. First he noticed that the gas "produced no uneasy feelings in the lungs," then that the inhalation of three quarts was followed by a loss of a distinct sensation of voluntary power. Finding there were no after-effects, he continued and discovered that after breathing six or seven quarts sometimes muscular movements were produced, and at other times he felt a sense of pleasure, which he manifested by laughing and dancing. Suffering from an inflamed tooth, he inhaled the gas and passed into blissful oblivion to recover in a few moments, when the pain returned.

'In 1799, Davy investigated the effects of nitrous oxide on animals, and later published his researches in an interesting book, on page 556 of which occurs this notable pronouncement: 'As nitrous oxide in its extensive operation appears capable of destroying physical pain, it may probably be used with advantage during surgical operations in which no great effusion of blood takes place.' In other words, I am sure Davy had discovered the idea, but the suggestion fell on deaf ears. I now ask you to carry your minds to the year 1818, and there you will find Michael Faraday saying, after many experiments, that he obtained the same results with ether that Davy obtained with nitrous oxide. The imagination of the medical world still remained untouched.

"Hickman, the centenary of whose death at the age of 29 we commemorate, began as a practitioner at Ludlow in Shropshire, and to him is the credit of appreciating the sufferings inflicted by surgical operations aud the conception of means to alleviate them by the production of insensibility.

"In a letter dater February 21, 1824, he writes: 'I have frequently lamented, when performing my own duties as a surgeon, that something has not been thought of whereby the fears may be tranquilised and suffering relieved.' Further, he was the first to put his ideas to the test of experiment. Hickman subjected animals to the inhalation of gases. First he put them in glass jars and they became temporarily asphyxiated. During asphyxiation he made incisions, applied ligatures, amputated ears and limbs, and without pain and with good surgical results. He next tried some experiments by letting the animals inhale carbonic acid gas. He was satisfied and

said to himself—Why, if this is true of animals, cannot we apply it to human beings? He published (August, 1824) his famous pamphlet—' A Letter on Suspended Animation, containing Experiments showing that it may be Safely Employed during Operations on Animals, with the View of Ascertaining its Probably Utility in Surgical Operations on the Human Subject. Addressed to T. A. Knight, Esq., of Downton Castle, Herefordshire, one of the Presidents of the Royal Society.'

" Hickman's researches were ignored by the medical profession in his own country, so in April, 1828, he went to Paris with a memorial praying that his work might be presented to the French Academy of Medicine. This was done and a Commission was appointed, but no investigations followed. The work to which he had sacrificed his career failed of recognition alike in France and England. Hickman returned home and died shortly afterwards at the age of 29.

" It was not till 1842 that a young doctor, Crawford Long, used ether for a definite surgical purpose. Then events followed more quickly. Wells, in 1844, employed nitrous oxide for anæsthesia. Morton, unaware of Long's work, administered ether in Massachusetts Hospital in 1846—the first public use of anæsthesia. Then a year later, Flourens — the distinguished physiologist, described the effects of chloroform on the lower animals and, following this, chloroform was employed at St. Bartholomew's Hospital by Sir William Lawrence and in Edinburgh by Sir James Simpson, who published the details of 50 cases in which he had administered chloroform with success.

" It is interesting to inquire why these many years separated the discovery from the adoption of anæsthesia. Was it because Great Britain was passing through a phase of apathy—of mind and perhaps also of feeling — which led to insensitiveness towards suffering? The necessity and even the pride of rapid operating may have excluded other considerations from surgeons' minds. The great Liston prided himself on being able to amputate a leg at the hip joint in under a minute. Hickman, though a young country practitioner, had the mind to see, the heart to feel, what anæsthesia meant for humanity—and strove to move his profession in England and France to action. Honour is his due and it is our privilege and happiness to perpetuate his fame."

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, May 29.

The Molecular Structure of Strychnine and Brucine. Bakerian Lectnre delivered by PROF. ROBERT ROBINSON, F.R.S.

No attempt will be made to give anything like a complete account of the chemistry of the alkaloids, but rather to develop an argument based on a limited number of the more significant facts.

Strychnine has the molecular formula $C_{21}H_{22}O_2N_2$, and is a mono-acid tertiary base containing no $CH_3.O.$ or $:NCH_3$ groups; it contains, however, the :N.CO. group (formation of strychnic acid by hydrolysis) and catalytic hydrogenation discloses the presence of one ethylenic double bond. Reduction in acid solution at a lead cathode furnishes strychnidine, $C_{21}H_{24}ON_2$, a di-acid, di-tertiary base, still containing the ethylenic double bond of strychnine. It is known that the cyclic amide group can be reduced electrolytically, and it is obvious that the -N.CO. of strychnine is changed to $-N.CH_2-$ in the formation of strychnidine.

Brucine, $C_{23}H_{26}O_3N_2$, is simply dimethoxystrychnine, $(CH_3O)_2:C_{21}H_{20}O_2N_2$, and therefore information derived from a study of this base applies also to strychnine; fortunately an unequivocal proof of this connection has recently been forthcoming.

The oxygen atom not contained in the .N.CO. group is considered to have ether character, (*a*) because of the chemical properties of such substances as dihydrostrychnidine, which contain neither C.OH nor :C=O, and (*b*) as the result of an argument based on the Leuchs degradation. This ethereal oxygen must be part of a heterocyclic ring. Since, therefore, strychnine cannot contain the group $C.CO.CH_2$., the ready formation of a benzylidene derivative must involve a group $:N.CO.CH_2$. as shown below:—

$$C_{17}H_{20}(O)(N)(N.CO.CH_2)(C:C)+Ph.CHO \longrightarrow C_{17}H_{20}(O)(N)(N.CO.C:CHPh)(C:C)+H_2O.$$

With nitric acid, strychnine gives first nitrostrychnine, then dinitrostrychnic acid, and finally, by degradation, oxalic acid, picric acid, 3 : 5-dinitrobenzoic acid, and an acid termed dinitrostrycholcarboxylic acid. This formation of simple benzene derivatimes is strong evidence that strychnine contains an aromatic nucleus and the direct attachment of N (*a*) to the latter is illustrated by the behaviour of strychnidine,

which, unlike strychnine, exhibits the properties of an aromatic amine with a free para-position.

Moreover, chromic acid can be used to burn away the aromatic ring, leaving the remainder of the molecule unaltered; strychnine and brucine have thus been converted into identical products (C_{16} and C_{17}-acids).

The position of the methoxyl groups is indicated by comparisons of the reactions of synthetic compounds with those of brucine.

Oxidation of strychnine with potassium permanganate affords strychninonic acid, $C_{21}H_{20}O_6N_2$, a keto-monocarboxylic acid containing two :N.CO. groups. The oxidation is represented by the scheme :—

$$C_{18}H_{19}(O)\overset{(b)}{(NCH_2)}\overset{(a)}{(NCO)}(C:CH) \rightarrow C_{18}H_{19}(O)(N.CO)(N.CO)(CO)(CO_2H).$$

On reduction with sodium amalgam, strychninolic acid is obtained, and this is stereoisomeric with a by-product of the original oxidation termed dihydrostrychninonic acid.

These acids have the groups :

$$C_{18}H_{19}(O)(N.CO)(N.CO)(CH.OH)(CO_2H)$$

Strychninolic acid is easily decomposed by hot, aqueous sodium hydroxide, furnishing neutral strychninoline, $C_{17}H_{16}(N.CO)(N.CO)$ (CH.OH), and glycollic acid, $HO.CH_2.CO_2H$.

Thus, it appears that strychnine contains the groups

$$:C\text{-}O.CH_2,CH:C\begin{matrix}C:\\C:\end{matrix} \quad \text{and} \quad \begin{matrix}:C\\:C\end{matrix}{>}N.CH_2\text{-}$$

which become

$$:C.O.CH_2.CO_2HCO\begin{matrix}C:\\C\end{matrix} \quad \text{and} \quad \begin{matrix}:C\\:C\end{matrix}{>}N.CO.$$

in the permanganate oxidation.

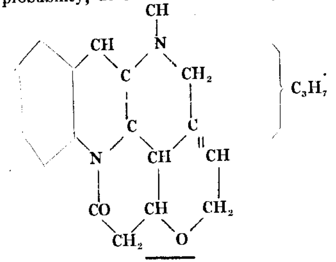
Detailed analysis of the possibilities, taking into account the further degradations of the isomeric strychninolones and brucinolones, enables the relation of this group to N (a) to be traced, and it is found that the strychnine molecule should contain the part skeleton,

$$:N(a).CO.CH_2.CH\text{—}O.CH_2.CH=\overset{C:}{C}\text{-}CH_2.N\begin{matrix}C:\\C:\end{matrix}$$

Strychninolone, furthermore, contains the groups

$$:N(a).CO.CH:CH.CH\begin{matrix}C:\\O:\end{matrix}, \ (CHOH) \text{ and}$$
(N (b) .CO).

Combining this with the conclusions already arrived at, we arrive with a high degree of probability, at the formula for strychnine.



INSTITUTE OF PHYSICS.

Presidential Address by Dr. W. H. Eccles, F.R.S.

May 27, 1930.

The Institute of Physics was ncorporated in 1920 to form a professional body of all physicists. Trained physicists had provided so many weapons of attack and defence during the war that there was every anticipation of their future importance in British industry during peace. Until nearly the end of the war physicists who were occasionally called upon to enter the service of the State were officially classed as " chemists " as the word " physicist " had not appeared in the official vocabulary; and those who had entered industry did so in the guise of " engineers." The need for a professional Institute of Physics was evident. The stability which the Institute has attained after ten years shows that its founding was justifiable. The purpose of this address is to show that the physicist has already proved his value in industry, and the subject of wireless telegraphy and telephony has been chosen for the address as an illustration of the constructive work of the physicists in a typical modern enterprise. In preparing an account of the contributions of physicists to wireless I shall omit all reference to the great engineers who have adorned the industry as otherwise my address would be a complete history. Hertz's experimental demonstration in 1888 of the physical existence of electric waves was the foundation of wireless. But Hertz's apparatus was insensitive, and therefore the detectors discovered by Lodge, Branly and Minchin in 1889 and 1890 were an essential to any prospective practical application. After these purely scientific in-

vestigations had provided the means and materials, wireless telegraphy was born at the British Association meeting at Oxford in 1894 when Lodge sent morse signals from a spark apparatus worked by a telegraph key and recorded them on a moving paper tape by receiving apparatus at a distance. Later in 1897 Lodge's laboratory produced the method of tuning aerials by inductance coils, thus enabling each transmitting station to correspond with a selected receiving station tuned to it. Another laboratory product was the arc generator of continuous waves (due to Duddell and Poulsen). It led the way to wireless telephony, which was developed rapidly by Fessenden, a professor of physics, until in 1907 the human voice was heard across the Atlantic. This ranks as the greatest achievement of wireless up to that date, for telephony was then impossible on long cables.

In 1918 the amplifying valve came to maturity; it was purelv the work of physicists, the use of a grid being traceable to the experiments of a German physicist in 1902. The coming of the valve brought two consequences, firstly the scrapping of the great spark stations which had been laboriously developed during 15 years of pioneer engineering work, and, secondly, after the war, the popularisation of wireless telephony in the form known as broadcasting. Many other less impressive technical developments and improvements can similarly be attributed to the introduction by the physicist, from time to time, of new principles and ideas into the technique of wireless.

At the present moment the industrialists of this country are indulging in profound self-examination and there is much discussion of the process called rationalisation which was brought into prominence in 1927 by the World Economic Conference at Geneva. The main object of rationalisation is to reduce the costs of production and operation in important industries, and its aspects are multitudinous. But keeping to the technological side, an important instrument of rationalisation is standardisation, and another is the modernisation of plant and products by the introduction of the latest invention and knowledge. Now there is a certain amount of contradiction here, for standardisation is opposed to modification; and the conflict has, so far as I know, not yet been thoroughly discussed. To put the matter another way, it is not economic to standardise machinery or products too soon, that is before the latest improvements have been incorporated, and, on the other hand, it is not economic to modify a standardised form until the costs of adopting it have been recovered. This conflict is well illustrated in the history of wireless and unceasingly appears in many industries, such as the electrical industry, and therefore the physicist is deeply concerned in it. To those responsible for making decisions it is no easy task to settle when to introduce improvements and when to stop improving in order to standardise. They probably regard the physicist as the villain of the piece; for he has been, in certain industries, the cause of many a sudden change of direction, the source of many a revolutionary idea. But the better view of the position of the physicist in this matter is that he possesses potentialities for helping as well as for disturbing the stability desirable even in progressive motion; being intimately connected with the laboratories whence spring the sort of invention that shatters the established technique he is better equipped than others to forecast in some degree the direction of forthcoming change and to assist in deciding the instant and mode for standardising and for modifying.

PENSIONS FOR GAS WORKERS.

Life pensions have just been granted to twenty-three co-partners of the South Metropolitan Gas Company. In the aggregate their service amounts to 550 years, or an average of nearly a quarter century; while their combined ages cover 1500 years. It speaks well for the conditions of their employment and the high standard of health among the workmen that the youngest pensioner to be retired is 59 years of age, while the eldest is seventy.

Four of the veterans—a labourer, a crane-driver, a foreman and a stoker—have served the Company for more than forty years.

The South Metropolitan Gas Company has a system by which a committee of workers investigate any accidents that occur in connection with their employment, and their recommendations are generally put into force. This system serves as an additional security for the Company's 10,000 employees.

SWISS TRADE IN MARCH.

With an excess of imports over exports amounting to 69.7 million francs, the trade balance for March was more unfavourable than in February, exports having covered only 69.4 per cent. of imports, as against 76.5 per cent. in February.

CANADA'S SILVER PRODUCTION, 1929.

Canada's silver production in 1929 showed a slight gain in quantity but a lower total value than in the preceding year. Production of silver in Quebec was slightly below the total for 1928 but the output from Ontario's properties showed a marked advance. British Columbia produced slightly less than in the preceding year; the Yukon production, on the other hand, was higher than in 1928.

The following table shows the production of silver in Canada in 1929 :—

Production.	Quantity. fine oz.	Value. $
Nova Scotia—		
In gold bullion—Total	132	70
Quebec—		
In gold ores; in blister copper, in copper ores and in silver-lead-zinc ores exported—Total	810,539	429,529
Ontario—		
In silver bullion and nuggets	7,345,561	3,892,633
In gold bullion	*256,781*	*136,076*
In concentrates, and slags exported by gold mines	99	52
In matte, blister copper and in ores, concentrates and residues exported.	1,341,473	710,887
Total	8,943,914	4,739,648
Manitoba—		
In gold bullion—Total	2,644	1,401
British Columbia—		
In alluvial gold	1,160	615
In gold bullion	1,363	722
In blister copper	623,804	330,573
In base bullion and ores exported	9,484,525	5,026,134
Total	10,110,852	5,358,044
Yukon—		
In alluvial gold	8,028	4,254
In ores exported	3,304,046	1,750,913
Total	3,312,074	1,755,167
Canada	23,180,155	$12,283,859

AREA GAS SUPPLY COMMITTEE.

BOARD OF TRADE ANNOUNCEMENT.

The Area Gas Supply Committee was appointed in January 1929, with Sir Alexander Walker as Chairman to carry out the investigation recommended in the First Report of the National Fuel and Power Committee into the technical and economic aspects of an area gas supply system (mainly fed by surplus coke oven gas) in the area lying between the Humber and Liverpool and between Leeds and Birmingham. The Report of the Committee has now been published and is obtainable from H.M. Stationery Office, or through any bookseller, price 3s.

In brief, the Committee have agreed that an elaborate gas network system in the Midlands would not pay its way and that as conditions are at present, even limited networks in Lancashire and West Yorkshire cannot be justified. But they recommend the establishment of a gas network in South Yorkshire. The total length of mains would be about 73 miles and it would be fed mainly by surplus coke oven gas, *i.e.*, gas at present bled to atmosphere or wastefully used under boilers. The gas from the network, which

in the early stages of the scheme is estimated to amount to 40 million cubic feet per day, rising later to 80 million cubic feet per day, would be absorbed mainly by the iron and steel industry in Sheffield and Rotherham. If the large consumers are to be induced to absorb these quantities the average price would need to be about 2d. per therm—a low price, lower even than that now charged by the Sheffield Gas Company which has a scale of charges which enables them to quote as low a price as any gas undertaking in the country. But on the calculations in the Report it appears that even at this price for gas, the network would pay.

The Report includes a great deal of technical detail regarding the South Yorkshire Scheme. The Committee have not accepted the view of the South Yorkshire Coke Oven Owners, who urged that they should own and operate any network in their district, but recommend, as a general principle, that Gas networks should be owned and operated by joint undertakings representative of the gas companies and coke oven owners. In the case of the South Yorkshire scheme some members of the Committee are prepared to agree that the network might be owned and operated by the Sheffield Gas Company.

The Report refers to the question of the legislative restrictions on the gas industry In the Committee's view industry must have cheap gas, and if an expanding market for gas is to be found, a more scientific method of charge than that now generally operative is necessary, provided a means is secured for affording protection to the "ordinary" or "domestic" consumer.

AMALGAMATED METAL CORPORATION LIMITED.

Amalgamated Metal Corporation Ltd., which holds all the shares of the British Metal Corporation Ltd. and Henry Gardner & Co. Ltd., is about to effect a substantial exchange of shares with the Metallgesellschaft of Frankfurt.

The object of the transaction is to secure co-operation in certain directions: whilst the provision of raw materials needed by the smelters and refineries associated with the two groups should be facilitated.

It is intended that each Company should have the right to representation on the board of the other.

Negotiations are already in an advanced state to bring about a similar arrangement between Amalgamated Metal Corporation Ltd. and the Sociëtë Gënërale des Minerals

OPENINGS FOR BRITISH TRADE.

Tenders are invited from Australia, British India, Canada, New Zealand, South Africa, Egypt, Turkey and Chile, and publicity is given in the *Board of Trade Journal* to requests from all parts of the world for agencies for British goods.

NOTICES OF BOOKS.

Trattato di Chimica Generale ed Applicata All Industria. Vol. II. *Chimica Organica.* Part II. By Dr. Ettore Molinari. Fourth revised and amplified edition. Pp. xvi + 661-1567. Milan: Ulrico Hoepli. 1930. Price 80 lire.

The late Prof. Molinari's name is so closely associated with pure and applied chemistry in Italy that his work has come to be regarded as the standard work on the subject. The present volume, which has been revised and brought up to date by Profs. Henry, Alessandro, Argellini and Contardi, all known for their contributions to organic chemistry, starts off with an account of the glycerides, oils, fats and waxes and the industries associated with these compounds.

Then follows an account of the carbohydrates, especially cellulose and its derivatives. The rest of the volume is concerned with the chemistry and industry of the aromatic substances, and their derivatives, dyes, textiles, proteins, and associated substances.

There are many illustrations of industrial plants and, in particular, six coloured diagrams of the processes employed in making soap, oil refining, sugar making and refining, making and synthetic indigo. There is also a chart showing Ostwald's colour circle.

The new volume is packed with the latest information concerning organic chemicals and their manufacture. It is a reference volume which should be accessible to all organic chemists.

Die Physikalische Chemie der Kesselsteinbildung und ihren Verhütung. By R. Stumper. Pp. 50. Stuttgart: Ferdinand Enke. 1930. Price 4 marks 80 pf.

Herr Stumper, who is an engineer, enumerates the boiler problems as (1) the formation of boiler scale or "fur," (2) the formation of slime, (3) dissolution of the metal composing the boiler, and (4) "bumping" and "frothing" during steam generation.

In the present monograph he discusses these practical problems from the theoreti-

begins by a detailed consideration of the solubility and deposition of calcium sulphate, and its pre-removal by precipitation with washing soda and with phosphates. The system $CaSO_4$, $CaSO_3$ and $BaSO_4$ has been studied in connection with the elimination of permanent hardness, which has apparently received more attention from the author than the formation of calcium and magnesium carbonates through boiling water containing the bicarbonates of those metals.

In seeking means of overcoming the formation of boiler scale and deposits the author has investigated several colloidal methods which have given satisfaction from the mechanical standpoint. Electrolyte processes have also been tried and are not without possibilities in the preparation of pure water without distilling or even heating the normal supply.

The Scientific Fundamentals of Gravity Concentration. By JOSEF FINKEY, E.M., Professor of Ore Dressing, School of Mines, Sopron, Hungary. Translated into English by C. O. Anderson and M. H. Griffiths. Bulletin, School of Mines and Metallurgy, University of Missouri, Rolla, Missouri. Price $1.

This excellent translation of Josef Finkey's "The Scientific Fundamentals of Gravity Concentration" gives the ore dressing profession the outstanding treatise on gravity concentration in recent years.

The authors realise the need of this classic in our literature, as the theory of this phase of ore dressing has been but lightly touched in our recent textbooks, although numerous scattered articles, particularly on coal preparation have appeared. It is fitting that this work be published at the present time when many of the large mining companies are expanding their research programs, as it gives the research workers a sound mathematical analysis of the laws underlying classification, jigging, and tabling processes.

The tremendous growth of the flotation process has, it is true, largely superseded gravity concentration in the metal field, but there remains the vast field of coal preparation and those metallic and non-metallic ores which lend themselves best to a combination of flotation and gravity concentration processes.

The original treatise, published in German in 1924, was well reviewed in the scientific Press. The authors preface their work in the following way:

"The existing textbooks of ore dressing, now antiquated book, deal essentially wit ore dressing machines and auxiliary appar tus in a descriptive way and skip over tl physics of ore dressing processes. A stud of the physical fundamentals is not onl necessary to the man who wants to unde stand the principles of the processes and tl manner in which the machines and appar tus work, but particularly to the practic operator who is anxious to obtain the highe efficiency of his machines, both from tl technical and commercial standpoint."

Professor Finkey's treatise is largely co fined to a mathematical exposition gravity concentration processes and l utilises the previous experimental works Richards, Stokes, Wagoner, Rittenger, ar others to interpret his deductions. (necessity, Professor Finkey employs high mathematics throughout his work, and uses hyperbolic functions to express h various conclusions.

The author derives equations for tl mechanics of gravity concentration inclu ing the dynamic action of a stream of wat against solids of various shapes and cond tions, the free fall of spherical solid bodi in still water, the motion of a spherical bod in a vertical stream of water, and the mov ment of a spherical body in a stream water flowing over an inclined plane.

He utilises these basic equations for d ducting the principles of screening a classifying according to settling rates a for the more complex processes of jiggi and tabling. Due to the complexity some of the equations, Professor Finkey h derived some simplified forms which ho for practical operation.

In addition to the derivation of fund mental equations, the treatise contai many observations and conclusions regar ing gravity concentration practice, partic larly European practice. This should be value to the operator who is attempting better his present results.

In summary, the writer believes that tl translation of Josef Finkey's treatise w find favour both in the operation and teac ing field of ore dressing. The authors a to be praised for their efforts in translati this work of fundamental principles and tl U.S. Bureau of Mines in co-operation wi the Missouri School of Mines for sponsori it. It will take its place among tl "classics" of ore dressing along with tl works of Rittenger and Richards. There room for further research in this branch ore dressing which has recently been eclips by the tremendous amount of work done

A Textbook of Inorganic Chemistry. Edited by J. Newton Friend, D.Sc., F.I.C. Volume XI. *Organo-Metallic Compounds.* Part II. *Derivatives of Arsenic.* By A. E. Goddard, M.Sc., A.I.C. Pp. xxviii + 605. London: Charles Griffin & Co., 42, Drury Lane, W.C. 1930. Price 42s.

Organo-metallic compounds, particularly those of arsenic, have assumed considerable importance. During the last two decades the number of such compounds has doubled, partly as a result of their application in gas warfare and partly from the search for compounds of therapeutic value. No less than four thousand organic arsenicals are described by Mr. Goddard in the present bulky yet precise volume on the derivatives of arsenic, which forms the most important series of organo-metallic compounds.

The author has attempted a classification of the organic arsenicals but, as mentioned in his preface, the nomenclature of organo-metallic compounds is exceedingly unsatisfactory. This applies to the derivatives of other metals besides arsenic, but is perhaps more serious in the case of this element since chemists in general will soon be obliged to acquaint themselves with the general characteristics of this class of compounds.

The aliphatic arsines include compounds of the types, $R\,AsH_2$ and R_2AsH as well as R_3As. These react readily with many reagents, resembling in some respects the amines. In addition to numerous halogen derivatives, series of arsinic acids $R.AsO(OH)_2$ and arsonic acids R_2AsOOH and their derivatives are known.

Even more important are the aromatic arsines and arsonium compounds, the aryl arsinic acids, and the arsenobenzenes and their homologues and numerous derivatives.

The cacodyl compounds of Cadet's early work and salvarsan are to-day merely two starting points in the preparation and study of the thousands of compounds now known and which cannot long remain ignored by organic and general chemists presuming to be acquainted, however slightly, with the whole field of the chemistry of the carbon compounds.

Mr. Goddard's volume is a most useful addition to the comprehensive series being published under the editorship of Dr. J. Newton Friend. The author has systematically described all the organic arsenicals in a clear and concise manner. He has been able to save some space by omitting details of the preparation of homologues as this mode of formation is based on a general method described for a typical member of the series. All associated with the publication of the present volume are to be congratulated on its excellence. In addition to the name and subject indexes there is a patent index.

J. G. F. Druce.

Achema Yearbook. Edited by Dr. Max Buchner. Pp. 260 + 64. Hanover: Deutsche Gesellschaft für Appparatewesen. 1930. Price 10 marks.

The Achema Yearbook is concerned with disseminating information on the chemical apparatus which has been made available for the different fields of chemical and technological research and large-scale-production. Among the articles contributed to the current annual for 1930 are several by outstanding German authorities. In the scientific section attention is directed to the apparatus most suited for science work in secondary schools, and to the construction of small scale apparatus illustrating industrial processes. New glassware, porcelain apparatus and balances are also described.

The bulk of the volume is taken up with recent advances in technical equipment and the latest available German machinery and plant for various industries is described in detail.

Dechema Monographie (11 Vorträge zum chemischen Apparate-Wesen) mit 8 Tabellen und 49 Abbildungen. Verlag Chemie, Berlin. 1930. Price 8 marks.

Die Deutsche Gesellschaft für chemisches Apparatewesen legt durch ihren rührigen Vorsitzenden, Dr. M. Buchner, das erste Heft einer Monographiereihe vor, welche in ausführlicherer Form, als sie die Zeitschrift "Die Chemische Fabrik" geben kann, die vielfachen Fragen der chemischen Apparatur in einzelnen Aufsätzen der Interessenten kreis vor Augen führen soll. Das schön ausgestattete Bändchen gibt die auf der vorjährigen Versammlung in Breslau gehaltenen Vorträge und führt uns dabei in die verschiedenen Aufgabegebiete der chemischen Apparatur ein. Der einleitende Aufsatz von *Heinel* entwickelt die Erfordernisse einer theoretischen Durcharbeitung des Energieüberganges. Die Normungsarbeiten, die trotz aller Schwierigkeiten schon so erfreuliche Fortschritte, vor allem auch in dem allgemeinen Verständnis für ihre Notwendigkeit, zeitigten, schildern dann *Traub* im Grossapparatewesen, *Plinke* in säurefestem Steinzeug, *Ehrhardt* in den Aräometerskalen. Laboratoriumsapparate behandeln *Kummen* in einer regulierbaren

Vorrichtung zum Lufteinblasen, die das Schäumen bei Vakuumdestillation elegant vermeiden läst, und *Wagner* in einer bequemen Ausbildungsform des Eintauchrefraktometers. Für den praktischen Betrieb gibt *Kranz* eine weitere Ausarbeitung des Junkers-Kalorimeteres für Heizwertbestimmungen, *G. Quincke* eine Kruppsche Grossbrechanlage für Kalkstein und *Neuss* die sehr übersichtliche Schilderung der atemschutzgeräte. Den Werkstoffen endlich ist *Groothoff's* Entwicklung der Fabrikation feuerfester Baustoffe und *Zimmermann's* Besprechung des Prodorits gewidmet. Wenn ich dem hübschen ersten Hefte eine lange Reihe schöner Nachfolger wünsche, so möchte ich gleichzeitig an die künftigen Autoren den Wunsch richten, in den Apparaturbildern, welche bei den Kalorimetern zuviel Details und unnötige Zifferbeschriftung, bei den Brecheranlagen eine verwirrende Feinzeichnung vorführen, die technische Grenze klarer Reproduktion zu berücksichtigen.

F. QUINCKE.

Matter and Radiation: with particular reference to the Detection and Uses of the Infra-Red Rays. By JOHN BUCKINGHAM, M.A. Pp. XII + 144. 1930. Published by Mr. Milford: Oxford University Press, Amen House, Warwick Square, London, E.C.4; or obtainable at Mr. Milford's German Branch at Bartels Hof, Markt 8, Leipzig, C.1. Price 7s. 6d. net.

The author in his preface says: I have endeavoured to set down an outline of the theory of radiation, and, particularly, of the properties and uses of that group of invisible rays which are known as the Infra Red. In order that the non-scientific reader may be relieved from an initial overload of strange words, which are a hindrance rather than an aid in acquiring a grasp of a new subject, I have avoided, so far as possible, the use of terms which are not a part of the vocabulary of everyday life. Mr. Buckingham has lived up to his words in this respect, but to carry out such a program is exceedingly difficult as the choice of words has to be made with very great care.

This book, though easy to read and not without many attractive features still leaves something to be desired. It seems unfair, however, to apply the magnifying glass too closely to works of this kind, as in a short moderately complete survey omissions become necessary and it is difficult to see how the author could have improved matters by more elaborate treatment.

Chapter I deals with electric waves. On page 6 a diagram with description explains up to a point the action of light in choosing a path in passing from air into water. On page 14 the diagram showing the extinction of light by two mirrors is clear, but brevity has excluded the mention of glass in this connection. Many features are discussed in this chapter and the half-tone illustrations of interference shown opposite page 20 are of interest. The æther receives some treatment.

Chapter II deals with atoms and molecules in an elementary way. On page 36 the author says: "The theory of Democritus was upheld by Lucretius in a poem (DE RERUM NATURA: Book I), parts of which might easily have been written fifty years ago, so accurately is the modern conception of the chemical atom foreshadowed." The author quotes thus: "First beginnings are of solid singleness, massed together and cohering closely by means of least parts, not compounded out of a nnion of these parts, but, rather *strong in everlasting singleness.*" This is better appreciated by reading it in connection with the subject as treated. Opposite page 50 a very fine half-tone illustration of a cathode-ray tube in action is shown.

Chapter III deals in a simple elementary way with the Bohr atom, radioactivity, and finally the author leads up to infra-red rays.

Chapter IV deals with the detection of infra-red rays, concluding with phosphorescent substances. The author says: Fused quartz which has been exposed to ultra-violet light gives a brilliant green light when strongly heated. The theory of this is obscure, but we may imagine that the electrons which had been displaced from their normal positions by the absorption of light are displaced still further by the heat, and that, when they have acquired this additional heat energy, they reach a stage at which their desire to return nearer to their homes is so strong that none of them can wait—they all rush back and give up energy in the form of light as they do so. This effect is the basis of a method of detecting infra-red rays, which is briefly described.

Chapter V deals with the uses of infra-red rays and is of practical interest. These headings may be mentioned. Detection of invisible objects at night. Infra-red rays for signalling. Telephoning by means of these rays. Burglar alarms. Fog penetration. Control of torpedoes and aircraft. Self-controlled target-seeking torpedoes. Photography. Penetration, etc. Infra-red

rays and climate. And finally : Use of infra-red rays in medicine. There two Appendixes. One on Electrons in their newer garb, and the other a mathematical outline of the Bohr theory. No treatments of the extensive advance in wave mechanics are of course given, and there is no index in this design of book, but a good contents is provided at the beginning.

MANCHESTER MUNICIPAL COLLEGE OF TECHNOLOGY.

We have received a copy of the prospectus of short courses of lectures and laboratory work to be given during the summer, 1930. There is given a summary and syllabus of Classes, Professors, Lecturers and other interesting information.

The syllabus of the Chemistry and Chemical Technology Department includes the following :—

Recent Advances in Colour Chemistry. Recent work upon indigo and thioindigo, indigosols and soledon colours. Perylene dyes. The chemistry of acenaphthene. Spectrophotometry of colouring matters. Quinoline sensitising dyes. Acetyl cellulose dyes. Dyes and mordants. The mechanism of diazo couplings. Diazotype process.

Some Modern Industrial Fermentation Processes.—Production of power alcohol, hydrogen, acetic acid and vinegar, acetone and butyl alcohol, lactic acid. Citric and oxalic acid fermentations by moulds. Starters for sour milk and cheese making. Flavouring yeasts. Bacteria associated with the curing of tea and tobacco, and flax retting.

...*Practical Inorganic Chemistry.*—The inorganic laboratory is available for the use of students who wish to revise or extend their practical work. The work may include preparations and qualitative and quantitative analysis.

Advanced Practical Organic Chemistry for A.I.C. and London B.Sc. — The work will comprise the study of typical organic reactions, and the qualitative and quantitative analysis of organic compounds.

Some Physico-Chemical Aspects of Inorganic Quantitative Analysis. General Theory.—The formation and general properties of lyophobic and lyophilic sols. Micellæ. The ageing of colloidal particles. The coagulation of sols. Dialysis. Ultrafiltration. Adsorption by precipitates. The washing of precipitates. The PH scale. Types of neutralisation curves. The theory and use of indicators. Solubility. Supersaturation. The process of crystallisation. The formation of precipitates. Amorphous and crystalline precipitates. Modern views on the structure of metallic hydroxides. Complex salts. Werner's theory. The X-ray examination of co-ordination compounds. The heteropolyacids.

Forthcoming Events

ROYAL INSTITUTION.

21, Albemarle Street, London, W.1.

Friday, June 13, at 9 p.m.—" Unemployment." By Professor Henry Clay.

THE ROYAL SOCIETY.

Thursday, June 12, at 4.30 p.m. The following papers will be read :—

" The Geographical Representation of the Mountains of Thibet." By Sir Sidney Buzzard, F.R.S.

" Cleavage Tests in Timber." By E. G. Coker, F.R.S., and G. P. Coleman.

" The Gyromagnetic Effect for Paramagnetic Substances." By W. Sucksmith. Communicated by A. P. Chattock, F.R.S.

" Experiments on the Exchange of Energy between Gas, Solid, and Adsorbed Layer in Vacuo. By M. C. Johnson. Communicated by S. W. J. Smith, F.R.S.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

15,141.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of arylsulphonic esters of 2.8-dihydroxy naphthalene-6-sulphonic acid. May 16.

Specifications Published.

305,488.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of vat dyestuffs of the anthraquinone series.

305,679.—I. B. Farbenindustrie Akt.-Ges. —Manufacture of vat dyestuffs of the benzanthrone series,

Abstract Published.

327,128.—Anthracene derivatives.—Johnson, J. Y., 47, Lincoln's Inn Fields, London. — I. G. Farbenindustrie Akt.-Ges; Frankfort-on-Main, Germany.

Anthracene derivatives are made by condensing 1 : 4-naphthaquinones partly or completely hydrogenated in the benzene nucleus with a 1 : 3-butadiene, or by condensing the products obtainable by condensing benzoquinone with a 1 : 3-butadiene under mild conditions, as described in Specification 324,661, with a different 1 : 3-butadiene. The products may be converted into anthraquinones and hydrogenated intermediate products by the process described in Specification 320,375. In examples (1) the condensation product from benzoquinone and 1 : 3-butadiene is further condensed with 2 : 3-dimethyl-1 : 3-butadiene, (2) 5 : 8-dihydro-1 : 4-naphthoquinone (example 10 of Specification 324,661), or 5 : 6 : 7 : 8-tetrahydro-1 : 4-naphthoquinone, is condensed with 1 : 3-butadiene, and (3) the condensation product from 5 : 8-dihydro-1 : 4-naphthoquinone and 1 : 3-butadiene is heated with alcohol and hydrochloric acid yielding 1 : 4 : 5 : 8-tetrahydro-9 : 10-dioxyanthracene, which has a bluish-violet colour probably due to the presence of a compound of quinhydronic nature.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

PERFUNDOL.

512,186.—Chemical substances used in manufactures, photography, or philosophical research, and anticorrosives. — I. G. Farbenindustrie Aktiengesellschaft, Mainzerlandstrasse 28, Frankfort-on-Main, Germany, May 21.

WETEXI.

512,097.—All goods in class 1 which i cludes chemical substances used manufactures, photography, philosophical research, and ant corrosives. — Chemical Buildi Products, Ltd., Kern House, 36 38, Kingsway, London, W.C.2. May 21.

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 10

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OTICE TO AUTHORS & CORRESPONDENTS.

Contributions for publication either as iginal articles or in the correspondence lumns are welcomed by the Editor of *he Chemical News.*

They must be accompanied by the conibutors' full names and addresses, not cessarily for publication, but as an dication of good faith. If a reply is eded or if it is desired that a manuscript hich is not accepted for publication be turned, a stamped addressed envelope ould be enclosed.

No notice can be taken of anonymous tters.

THE CHEMICAL ATOM IN THE CONCEPTION OF DISCONTINUOUS MATTER. H, He, Li, C. VAN'T HOFF'S CARBON TETRAHEDRON.

By W. TOMBROCK.

The Atom.

The conception of discontinuous matter, which takes as its starting point, motion and collision and as object, an understandable explanation of nature, leads on the assumption of the electron to be a material particle of larger volume, to a proton which appears as a whirl in an ether with simple atoms.

The recognised stability of the chemical atom demands an understandable connection or coupling between the protons in it. This coupling suggests itself in a common path of secondary orbits of motion set up by the protonic whirls, these secondary orbits appearing as circular whirlwiuds round the primary protonic centres of motion. These secondary orbits of motion would at the same time explain the circular or elliptical motions of the " spinning " electron.

We propose to give a somewhat arbitrary representation of such proton couplings for hydrogen, helium, lithium and carbon.

Hydrogen.

Let us represent the primary protonic whirl by a spiral, then two points A and B in the cross-section may appear as central points of the circular secondary orbit of motion (Fig. 1.) A succession of such points then forms the circle round the centre of the primary protonic motion, A and B being points of the core of the secondary ether current or wind round the primary protonic centre of motion. The arrows show how ether-particles which are not included in the actual maelstrom of the proton and thus do *not* share in the primary protonic motion, but might come to move in a somewhat circular fashion around A and B, thus suggesting the spinning round of an electron in its moving on in the secondary circular ether-whirl.

Let us now put two protons side by side with the axes of primary motion parallel but with, however, their motions in opposite directions, then the two secondary orbits of motion temporarily coincide over a portion of their path. B would coincide with A′ of the other secondary orbit; the whirl around these coincident points—shown by the arrows—we then perceive as being in the direction of the motion of the hands of a clock for both points. And an electron describing an orbit round the first proton

might now also on a very slight impulse come to move in the orbit round the second proton; its orbit does *not*, however, then become, as you might think, an ellipse with the two primary protonic centres of motion as the foci, but it takes the shape of the figure eight.

The coupling here described between *two* protons cannot, however, be very stable and may be thought of as a combination of two H atoms in the hydrogen molecule (Fig. 2). Elements with two or three protons, *atomic weight 2 or 3, are not known.*

Helium.

On the other hand the He atom must consist of four protons. This is thus the first multi-protonic element.

If we indicate the axes of primary protonic movement by arrows and the sections of the planes in which the secondary orbits lie, by dotted lines (Figs. 2-3), then we see *directly how the four secondary orbits can* couple together in the atomic centre *(Fig. 4). The axes of the protons thereby* lie, so to speak in one plane.

This configuration is to be considered as closed—in the sense of being incapable of entering into chemical combination. The He molecule itself is monatomic. It gives an inert gas. The elements that are group relations of He, being themselves also chemically inert, may first and foremost be thought of as combinations of several inert helium nuclei, which thus could yet be combined, however, only under very special circumstances (at the origin of these elements). It also deserves mention here that in spontaneous disintegration of the radioactive elements it is just the inert helium-proton-quartet which is set free.

We do not, however, perceive couplings of this He quartet with one or two protons to the formation of a new element.

Lithium.

The next element is Li, which we represent schematically *in Fig. 5. Arrows and* dotted lines have the same significance as in Fig. 2-4. There are thus two common paths for the seven secondary circular orbits of motion: which common paths are perpendicular to the plane of the paper with the direction of motion in opposite senses, as may be deduced from the figure. The whole configuration of protons must be considered to be more open than in He. The arrows representing the axes of primary *protonic motion may exhibit this*: two of the primary currents here go straight to*wards each other and another two away* from each other. Li is chemically active.

Carbon.

According to the van't Hoff conception it can hardly be anything else than that the 12 protons must in this case combine by three. In addition they must then have

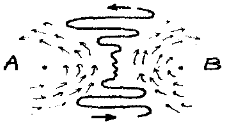


fig. 1 - proton

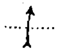


fig. 2 - proton

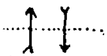


fig 3. H_1

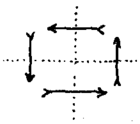


fig 4 - He

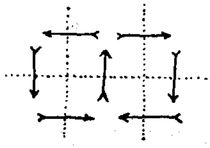


fig. 5 - Li

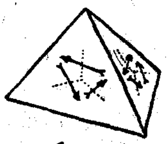


fig. 6 - C - van't Hoff

The atomic number of the elements may also be read off from the representations here given, namely, in the number of planes into which the secondary orbits of motion fall. On account of the coincidence of some planes, these numbers turn out to be the following:— H : 1, He : 2, Li : 3 and C : 6.

other mutual couplings in order to form one combination. It is easy to see how (Fig. 6). If we draw four axes from the centre of the tetrahedron to the four corners and also four axes from the centre to the middles of the side-faces, then eight common intervals of secondary circular orbits of motion partially coincide with these two systems of axes and indeed towards the centre on the one system and away from the centre on the other. Ether thus streams through a reasonable arrangement of the 12 protons, so to speak, inwards at the centres of the four faces of the van't Hoff tetrahedron and outwards at the four corners . . . or *vice versa*, if you will.

No element being known as consisting of three protons, the carbon proton triad must have become stable through its combination with three other triads, thus forming the atomic configuration which plays such a preponderant rôle in organic stereochemistry. Whereby it becomes self-evident that this triad is to be considered as much more open than the helium quartet of protons. Carbon is tetravalent whereas helium is chemically inert. Thus the conclnsion may be drawn that the carbon atom is, indeed, built up in a manner suggested, almost immediately, by the conception of van't Hoff.

FLUORSPAR IN CANADA.

A report on the fluorspar deposits of Canada has been published by the Geological Survey, Dominion Department of Mines, Ottawa. Fluorspar of fluorite is a non-metallic mineral of importance but is one that is not produced in great quantities, the world production seldom exceeding three hundred thousand tons.

It has a variety of uses. It is used as a flux in metallurgical industries. It enters into the composition of enamels and certain kinds of glass, and is used in the the manufacture of artificial cryolite, which is employed as a flux in the recovery of aluminum. It is employed in the chemical industry for the manufacture of hydrofluoric acid and other fluorine compounds; transparent colourless varieties are used for optical purpose.

Fluorspar is widely distributed throughout Canada but most of the known occurrences are of mineralogical interest only. There are two producing localities,—near Madoc, Ontario, and near Grand Forks, British Columbia. There was no production in 1920 to 1928. The output for 1929 was 70 tons from Ontario, and 17,870 tons from British Columbia.

The deposit worked at the Rock Candy mine, near Grand Forkes, British Columbia, consists of one large ore-shoot made up of an intricate network of more or less parallel replacement veins varying in width from a few inches to thirty feet in a mass of syenite. At Madoc, Ontario, the mineral occurs in veins nearly horizontal Palæozoic sediments and in the Precambrian complex on which the Palæozoic sediments rest.

This report is one of a series on economic geology being published by the Geological Survey. Other volumes of the series deal with the talc deposits and the arsenic deposits of Canada, the iron ores of British Columbia and Yukon and oil and gas in western Canada (stock now exhausted), and there is a general report on the geology and economic minerals of Canada. Application should be made to the Director of the Geological Survey, Department of Mines, Ottawa, Canada, or to the secretary, Office of the High Commissioner for Canada, The Canadian Building, Trafalgar Square, London, S.W.1.

A speeial " Orient Number Supplement " of the *Prager Presse* appeared on Jnne 1, giving in great detail an acconnt of the industries, finance, needs and conditions in Greece, Bulgaria an dTurkey. There were also numerous authoritative articles by leading industrialists and publicists of the respective countries.

The same issue also contains much information concerning the industrial activity of Czechoslovakia, including the chemical, metallurgical, sugar and mining industries which play an important part. Among other interesting information it is mentioned that the Ringhoffer Carriage and Wagon Works originated from a boilermaker's shop founded by Francis Ringhoffer in 1771. The building of railway carriages and wagons was started in Prague-Smichov in 1852. The Works occupy an area of 312,000 square metres, and their annual output when in full swing amounts to 600 passenger cars and brake vans and 6000 goods wagons. Until the end of 1929 altogether 134,370 various vehicles were supplied such as saloon-cars, sleeping- and dining-cars, passenger cars, brake vans and goods wagons of various types, tenders, electric locomotives, tram cars and various vehicles for military purposes. The works supply their products not only to Czechoslovakia but also for almost all the principal countries of Europe and to Egypt, Algiers, Tunis, Anatolia, India, China, Argentine, Brazil, etc.

THE COLLINSICS OF PROPYL CHLORIDE, PROPYL BROMIDE AND ETHYL BROMIDE.

By Hawksworth Collins, B.A. (Camb.).

The word " Collinsic " for the future means much more than was signified by it in the 180 already published. All facts, which corroborate it, are now included.

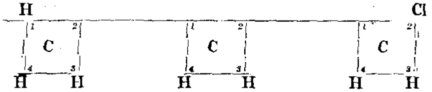
The collinsic of propyl chloride is first given fully in table XXVIII, without the experimental data, followed by an abbreviated form in table XXIX with the experimental data. Then the other two are given in the abbreviated form in Tables XXX and XXXI. The full diagrams for the group CH_2 may not be given again for some time, so that any one who wishes to follow the further publication of organic chain compounds should keep Table XXVIII for reference.

The rectangles represent atoms of carbon, the valences of which are supposed to emanate from the four corners. The latter are numbered owing to the discovery that " The Valences of Carbon are Unequal."

R.V. = Relative Volume;
O.R. = Optical Refractivity;
M.R. = Magnetic Rotation;
H.C. = Heat of Combustion;
H.F. = Heat of Formation.

Table XXVIII.

Propyl Chloride.



R.V.	15.25	0.71	5.76	9.95	0.71	5.76	9.95	0.71	5.76	9.95	23.01
O.R.	4.23	2.6685	0.83	3.425	2.6685	0.83	3.425	2.6685	0.83	3.425	10.82
M.R.	0.235	0.459	0.399	0.164	0.459	0.399	0.165	0.459	0.399	0.165	1.752
H.C. *gas*	27100	104218	26375	27194	104218	26375	27194	104218	26375	27194	-8127
H.F. gas	7280	-7800	8005	7186	-7800	8005	7186	-7800	8005	7186	8127

This Table is intended to be read as follows :— Whenever the R.V. of an atom of hydrogen is 15.25 in any organic substance, its O.R. is always 4.23, M.R. 0.235, H.C. (gas) 27100 and H.F. (gas) 7280; and so on, reading downwards in each case.

The above is an extended or corroborated voloptic, but the word " voloptic " will still be used to denote this extension.

Relations Between the Values in Table XXVIII.

27100	+	**7280**	=	**34380**	34180	Thomsen
27194	+	**7186**	=	**34380**	34500	Berthelot
26375	+	**8005**	=	**34380**		
104218	-	**7800**	=	**96418**	96400	Gottlieb
					96960	Thomsen
8127	-	**8127**		**0**		

Table XXIX.

181.

Collinsic of Propyl Chloride.

		Theor. Column	Obs. Column	
	H + $(CH_2)_3$ + Cl			
	35.822 = 0.4093(15.25 + 16.42_3 + 23.01)	**0.897**	0.896	19° Linn
		1.4093	1.3954	Watts
O.R.	**35.8205 = 4.23 + 6.9235_3 + 10.82**			
M.R.	**0.235 + 1.023_3 + 1.752 =**	**5.056**	5.033 - 5.111 P	
H.C.	**27100 + 157787_3 - 8127 =**	**492334**	492380 T.	
H.F.	**7280 + 7391_3 + 8127 =**	**37580**	37760 - 36020 T.	
(H.F.)	**240660 = 7 × 34380**			
	289254 = 7 × 96418			
	529914			
	492334			
	37580			

Explanation of Table XXIX.

If the molecular weight of propyl chloride be divided by the S.G. 0.897, the result is 87.52, which is the sum of the volumes between the brackets in the second line. When the total volume 87.52 is multiplied by 0.4093 ($\mu - 1$) the result must be correct to at least four figures with the sum of the O.R.'s of the elements of the molecule just below; and the theoretical μ must be within 1 per cent. of the experimental. The above *three corresponding values are the three* colls which have been demonstrated in each one of the first 180 collinsics. In this collinsic there are three morre colls, *viz.*, those of M.R., H.C., and H.F. The last calculation of H.F., which in every case is denoted by (H.F.), will always be identically equal to the preceding calculation. It merely shows that the present investigator's method of finding the H.F. of a substance is exactly the same as Thomsen's method.

Table XXX.

182

Propyl Bromide.

		Theor. Column	Obs. Column	
	H + $(CH_2)_3$ + Br			
	41.005 = 0.4481(15.25 + 16.42_3 + 27)	**1.344**	1.3497	0° Pier
			1.353	16° Chap
		1.4481	1.428	calc. from 23.56 B
O.R.	**41.0005 = 4.23 + 6.9235_3 + 16**			
M.R.	**0.235 + 1.023_3 + 3.59 =**	**6.894**	6.878 - 6.896 P	
H.C.	27**100 + 157787_3 - 0.895 =**	**499566**	499260 T	
H.F.	**7280 + 7391_3 + 0.895 =**	**30348**	30850 - 29110 T	
(H.F.)	**240660 = 7 × 34380**			
	289254 = 3 × 96418			
	529914			
	499566			
	30348			

Table XXXI.

183

Ethyl Bromide.

		Theor. Column	Obs. Column	
	H + $(CH_2)_2$ + Br	**1.45**	1.45	15_3 P
	34.076 = 0.4538(15.25 + 16.42_2 + 27)	**1.4528**	1.443	calc. from 18.89 B
O.R.	**34.077 = 4.23 + 6.9235_2 + 16**			
M.R.	**0.235 + 1.023_2 + 3.59 =**	**5.871**	5.828 - 5.873 P	
H.C. gas	**27100 + 157787_2 - 0.895 =**	**341779**	341820 T	
H.F. gas	**7280 + 7391_2 + 0.895 =**	**22957**	23000 - 21840 T	
(H.F.	**171900 = 5 × 34380**			
	192836 = 2 × 96418			
	364736			
	341779			

It is not often that the full experimental data for a substance are available, as in these three instances, so that in general the ordinary collinsic of an organic substance will only be supported by some of these.

It was shown in the *Chemical News*, 1921, 122, 62 *et seq.*, that the relative volume of an atom of hydrogen in the first place of a carbon ato mis 15.25, and that in the second place 12.22. When this had been done, the space required for the demonstration could not be accorded, so it was given up for the time. It is now unnecessary to demonstrate the way in which the remaining two volumes of H and that of C were found, as the collinsics will make this matter clear.

In propyl bromide the theoretical and observed refractive indices differ by about 1.5 per cent. This is the only case in the first 183 collinsics in which the two differ by more than 1 per cent. But it must be remembered that Bruhl may not have employed the exactly correct atomic weights and specific gravity in his calculation of 23.56; and then it has been necessary for the present investigator to calculate the R.I. 1.428 from Bruhl's result, since he has not been able to find any record of the observed R.I.

SUMMARY.

There are six new voloptics introduced in this paper, three for H, one for C, one for Cl (liquid) and one for Br (liquid). These will remain the same in all organic liquid molecules. *E.g.*, the volume of an atom of H in the fourth position of a carbon atom will always have a volume of 5.76, its O.R. will always be 0.83, M.R. 0.399, H.C. gas 26375, and H.F. gas 8005 in all kinds of molecules. So it is evident that each atom in these three molecules is differentiated in five different ways.

This H-atom has the same volume as the hydroxyl H-atom, but a very different O.R. The latter has been already demonstrated more than a thousand times in the first 180 collinsics to have the O.R. 2.613. This is the first example of an atom having two values for O.R. whilst the R.V. remains the same.

A number of new aromatic antimonials, notably stibamines and stibino-benzenes have been prepared by U. P. Brahmachari and J. M. Das Gupta and are described in their "Contribution to the Chemistry of certain new aromatic Antimonials" in the *Journal and Proceedings* of the Asiatic Society of Bangal, 1929, vol xxv.

GENERAL NOTES

SIMULTANEOUS SPEECH TRANSMISSION IN SEVERAL LANGUAGES.

A remarkable and perhaps epochmaking innovation in the reception of speeches at international gatherings is being tried out at the meeting of the Second Plenary World Power Conference in Berlin (June 16th—25th). It will be possible to follow addresses and discussions in any of the three official languages of the Conference — English, German, or French—no matter which of these languages is being used by the speaker.

Placed in front of each seat in the auditorium is a pair of headphones, connected to a specially designed switch box by means of which the listener can switch in to the language he best understands. In addition a volume control is included.

The speakers and the interpreters, who translate on the spot, all speak into microphones equipped with sound proof mouthpieces. To allow two interpreters to relieve each other without interruption, two microphones are connected in parallel. The speech-currents are transmitted to an amplifier and then to the switch boxes of the listeners.

SILVER MINING IN CANADA.

Silver mining in Canada is not a distinct industry, as this metal generally occurs not alone but with lead and zinc; with cobalt, nickel and arsenic; with lode and placer gold; in copper-gold ores; or in nickel-copper ores. Silver in lead and zinc ores and in cobalt-nickel arsenic ores is generally the predominating factor in determining the marketability of such ores. Silver-lead-zinc mining is a very important industry in British Columbia, the Yukon Territory, Quebec, and to a less extent in Ontario, whereas silvercobalt mining in Canada is restricted to Ontario.

The statistics contained in a Report issued on the industry, are the final figures for the year 1928, when the Canadian production totalled 21,936,407 fine ounces valued at $12,761,725. Owing to the state of the silver market, the figures for 1929 were lower in respect of value in spite of an increased production, the quantity produced last year being 23,180,155 fine ounces worth $12,283,859. Silver held the seventh place in 1928 in the list of minerals produced by Canada from the point of view of value, and the Dominion ranked third among the world's silver-producing countries.

CANADA'S MINERAL PRODUCTION.

According to the Dominion Bureau of Statistics at Ottawa, Canada's leading mineral products showed gains for January, 1930, over December, 1929, in the output of coal, feldspar, natural gas and zinc. In comparison with the totals for January, 1929, the figures for January, 1930, were higher in coal, copper, feldspar, gold, natural gas, petroleum, salt, silver and zinc. In this connection it may be noted that new production records were established in the year 1929 for the outputs of copper, gold, natural gas, petroleum, salt and zinc.

A feature of the month's record was the rise in coal output to a point 7.6 per cent. over the average for January in the five preceding years. Copper production was five million pounds higher than the January, 1929, figure, although slightly below the December total. Gold production showed a similar trend, the figure for the month being above that for January, 1929, but below the total for December, 1929. Natural gas showed continued improvement over both the January and December, 1929, figures. Petroleum and salt outputs were greater than in January, 1929, but less than the totals for December. Silver production, while higher than in January, 1929, was about 22 per cent. below the output in December, but it is possible the December output included silver recovered from clean-ups for the year. Zinc showed a continued advance, rising over both the preceding January and December totals.

		December 1929	January 1930	January 1929
Asbestos	tons.	19,731	17,117	17,882
Cement	brls.	278,631	269,195	385,679
Clay Products	$	652,200	477,449	494,034
Coal	tons.	1,490,836	1,630,198	1,585,072
Copper	lb.	25,407,295	24,936,756	19,850,095
Feldspar	tons.	2,333	2,540	2,114
Gold	fine oz.	168,638	154,114	150,475
Gypsum	tons.	38,209	11,277	30,936
Lead	lb.	31,744,345	23,231,247	24,668,121
Lime	tons.	42,751	42,437	43,652
Natural Gas	M. cu. ft.	3,459,026	3,888,517	3,365,525
Nickel	lb.	10,834,379	9,228,010	9,705,455
Petroleum	brls.	101,365	100,496	54,874
Salt	tons.	25,876	24,530	23,131
Silver	fine oz.	2,192,073	1,709,222	1,701,081
Zinc	lb.	17,639,781	17,754,289	15,953,322

CANADIAN TRADE WITH THE UNITED KINGDOM AND THE U.S.

Figures issued by the Dominion Burea of Statistics, Ottawa, show that imports for consumption in Canada from the United Kingdom during March were valued at 16,310,686 dollars, while exports of Dominion produce to the United Kingdom were valued at 16,867,748 dols. For the twelve months ended March 31 the totals were 189,178,156 dols. and 281,838,175 dols. respectively, as compared with 194,041,381 dols. and 429, 730, 485 dols. in the previous twelve months.

The value of imports for consumption in Canada from the United States during March was 78,760,996 dollars and that of exports of Dominion products to the United States 43,330,698 dols. For the twelve months ended March 31 the total values were 847,466,079 dols. and 514,957,553 dols. respectively, which compares with 868,012,229 dols. and 499,612,145 dols. for the previous twelve months.

THE CHEMICAL INDUSTRY OF POLAND IN 1929.

The general economic situation of Poland, which was less favourable in 1929 than it was two years previously, is also reflected in the chemical industry, whose trade showed a certain decline. Nevertheless, such difficulties did not in any way arrest the development of the chemical industry and its numerous branches show important progress during last year.

Synthetically obtained nitrate compounds show the greatest amount of progress during the year 1929. The output of ammonium sulphate with ammonia at Knurow (Upper Silesia) reached 18,000 tons per annum. At Wyry (Upper Silesia) factories were opened for the synthetic manufacture of ammonia after the system of the "Nitrogen Engineering Corporation" giving an output of about 6,000 tons of ammonium sulphate. At Chorzow a similar factory was opened during the latter half of the year yielding 25 tons of synthetic

ammonium per diem. In 1929 the construction was completed of a second State factory for nitrate compounds at Moscice, near Tarnów, calculated to produce 60 tons of ammonia per diem.

Owing to the above developments the total production of synthetic nitrate compounds reached 47,000 tons in 1929.

Other artificial fertilisers do not show any increase owing to the unfavourable situation in agriculture during the latter half of 1929, on the contrary, in some cases their production is lower than that of the previous year.

However, this decrease in the production of superphosphates is not reflected in that of sulphuric acid which—in spite of the progress made during the past few years—is not yet adequate to the demands upon it. The development in the production of sulphuric acid is illustrated by the following figures :—

	Tons of Sulphuric Acid 50° Be
1926	231,847
1927	290,857
1928	330,891
1929	387,924

As regards soda compounds, very noteworthy is the progress made in the production of sodium which reached 100,160 tons last year, as compared with 90,130 tons in 1928.

Apart from the above-mentioned progress made in the production of nitrate compounds, remarkable progress has been made in the electro-chemical industry, especially with regard to the electrolysis of rock salt and potash salts and also the production of carbide.

A considerable increase in the production of coke has been effected by the increased output of coal derivatives as is shown by the following figures (in tons) :

	Tar	Raw Benzene	Ammonium Sulphate*
1926	51,900	14,700	17,000
1927	66,100	17,800	20,800
1928	78,800	21,100	24,800
1929	85,300	22,300	25,000

In connection with the increased production of the basic coal derivatives, emphasis must be laid on tar distillates.

Of all the branches of synthetic-organic industries the one most affected by the general economic conditions is the dye industry owing to the decreased output of textiles. The output of synthetic dyes shows a certain decline as compared with the previous year, nevertheless, as regards the perfecting of the product, the industry has made great strides both as regards the manufacture of new dyes and the perfection of those already manufactured.

Other branches of the chemical industry which have made progress during the past year are especially the pharmaceutical industry, chemical wood products and artificial silk. In spite of the unfavourable position both on the home and on foreign markets, the latter shows signs of progressive production and exportation. The exports of artificial silks have increased threefold as compared with the previous year. Favourable progress is also reported from the oil and other industries.

Though general conditions were none too good in 1929, this did not deter the chemical industry from carrying out extensive investments, and in many branches improved technical installations have been introduced.

As the Polish State attaches great importance to the development of the chemical industry, it has come forward with help in different forms, *inter alia* with financial help by granting large credits. This assistance was especially opportune during the crisis of 1925-26 when, in order to keep several of the larger factories going, the National Economic Bank granted them important credit both for the increase of their capital as also for their working capital.

The splendid progress made by the Polish chemical industry has attracted foreign capital especially in France and Belgium. Both financial circles as well as chemical undertakings in these two countries have entered into close relations with several undertakings in Poland. British enterprise, however, has not yet wakened up to the possibilities offered by the chemical industries of Poland.

* Without synthetic products.

INDUSTRIAL PRODUCTION IN MARCH QUARTER.

Industrial activity in the United Kingdom in the first quarter of 1930 was 2.6 per cent. smaller than in the last quarter of 1929, but 0.4 per cent. greater than in the first quarter of last year, the index numbers for these periods being 110.9, 113.9 and 110.5 respectively. The fall from the preceding quarter was due to a decline of 3.6 per cent. in the manufacturing industries, which was partially offset by an increase of 1.7 per cent. in the mining group.

SMOKE AND HEALTH.

By J. S. Taylor, M.D., D.P.H.,
Assistant Medical Officer of Health, Manchester.

A Lecture delivered at the Manchester College of Technology, under the auspices of the Joint Committee of the Manchester and District Regional Smoke Abatement Committee and the National Smoke Abatement Society.

Anything which will prevent injury or which will improve the well-being of a race is deserving of our profoundest attention and concentration. During the last 50 years the problems of pure water supplies, efficient sewage disposal, epidemic disease and housing have all been faced, with a certain degree of success. There remains in atmospheric pollution one of the greatest enemies of health, an enemy persisting through the uneconomic and unscientific methods of producing power and heat for our industrial and domestic purposes.

Practically all the smoke nuisance from which we suffer is due to the use of bituminous coal for heating purposes, both in the factory furnace and in the domestic hearth. It is composed of carbon, hydrocarbons and ash, (i.e. volatile matter and coke) with a varying amount of sulphur and moisture. Completely burnt these constituents are converted into carbon dioxide, water and sulphur dioxide, the ash alone remaining.

With imperfect combustion, a portion of the volatile matter is distilled off which separates out into sooty matter forming smoke. This soot consists of carbon mixed with tarry matter and sulphur acids, mixtures inimical to health.

To-day in Manchester 3,000,000 tons of coal are burned annually of which three quarters of a million are used for domestic purposes. Eleven hundred factory chimney and one hundred and fifty thousand houses are almost continuously discharging into the air the products of the incomplete combustion of these millions of tons of coal. As a result 20,000 tons of solid matter fall annually in the city area, and tar and acids to the amount of 75,000 and 200,000 gallons respectively. And this in spite of the fact that during the last 30 years the industrial smoke emission in the city has been reduced by approximately 75 per cent.

It does seem strange that of the three necessities of life, viz :—food, water and air, legislation for air should have been so long delayed in spite of man consuming seven times as much of it by weight as he does food and water daily.

Respiratory Diseases.

We breath this fresh air and we inhale about 35 lbs. of it daily. As a result, dwellers in the industrial cities, have lungs more or less similar to those of the coal miner, not pinkish in colour like those of a child or of one who tills the fields, but blackened, both on the surfaces and in the depths, due to the deposit of carbon. The tarry matter and the less visible sulphur acids which are far more dangerous than the carbon, set up an irritation in the mucous lining of the windpipe and smaller tubes.

Chronic catarrh supervenes. The mucous lining becomes rough and thickened, the surrounding tissues lose their elasticity and become leathery in texture. These changes produce symtoms of chronic bronchitis, symptoms resulting from persistent irritation, partial collapse of the lungs and incomplete oxygenation of the blood. To make up for this deficiency certain areas of the lungs undergo compensatory distension. The air vessels are enlarged but, owing to the change in their lining are functionless. Their walls are atrophied and the fine net-work of blood vessels disappears—a condition termed emphysema. Now the blood is incompletely purified; the heart has to work overtime to rid the blood of its poisonous gases; ultimately like the completely exhausted but flogged horse it stands still—heart failure. This, therefore, is the sequence of pathological changes, catarrh, bronchitis, emphysema, heart failure.

It has been found that there is a large accumulation of sulphur acids in the air during fogs.

On a clear day the amount of SO_3 varies from 1—3 mgm.

On a hazy day the amount of SO_3 varies from 3—6 mgm.

On a foggy day the amount of SO_3 varies from 8—30 mgm.

and it has been proved that as the fog continues the amount of SO_3 markedly increases the fog and smoke acting as a blanket which prevents the free diffusion of these acids.

Thus, during fog on December 21st the amount of SO_3 in mgm. per 100 cub. ft. at 10 a.m. was 16.48, at 4-30 p.m. 22.59. Again, on December 23rd the amount of SO_3 at 10 a.m. was 12.0 mgm., at 9 p.m. 18.34.

Again, it is a well-known fact, established both scientifically and in industrial life, that tars and mineral oils produce cancer, e.g. in the shale oil industry, in mule spinning in

Lancashire and many other industries. A very striking additional piece of scientific evidence has recently been foreshadowed in investigations made by Professor Shaw Dunn and Dr. Duguid (2) whose inquiries support the view that there is an appreciabl greater incidence of cancer of the thorax in places where the atmosphere is smoke-laden. These findings have been corroborated by the Leeds Research workers. (3).

But there are other conditions for which this blanket of smoke is responsible, not on account of its irritating constituent soot, but on account of its cutting off of the sun's rays and particularly the ultra-violet rays.

There is evidence on every hand that observant men have recognised the importance of light for thousands of years and in all stages of civilisation. From the days of the earliest sun-worshippers, venerating what to them was a mysterious and awe-inspiring phenomenon, up to the modern times when few religions do not include light as one of the manifestations of divine power, human beings have regarded the sun's rays with feelings of gratitude and reverence. But alongside this spiritual attitude there has been an impulse to take full advantage of the benefits which, as men must have found, even while their understanding was primitive, were to be derived from the sun. The ancient Egyptians, Greeks and Romans were all firm believers in the health-giving efficacy of its rays, and their medical men prescribed them both for the cure and prevention of all the various ills and diseases which affected humanity.

But it was not until the late 17th century when Newton discovered the spectrum that the investigation of radiant energy and of light was made possible. With the simple apparatus at his disposal he was unaware of the existence of a vast series of radiations differing in respect of wave-lengths and frequency of vibration (only a small part of which is visible light), and it was left to Herschel, 1800, and to Ritter, 1801, to announce the infra-red and ultra-violet regions to Rontgen, 1895, to describe his experiments with X-rays, to Marconi, 1899, to apply successfully the researches of Hertz to wireless telegraphy, and to Madame Sklodowska-Curie, 1902, to prove her discovery of radium.

THE BIOLOGICAL ACTION OF LIGHT.

Much of the present knowledge of the biological action of light is due to the researches of Leonard Hill and his collaborators.

The epidermis reflects and scatters rays which fall upon it, but some portion of the visible rays penetrate and are absorbed by the blood, warming it. The dark heat rays on the other hand are mostly absorbed by the epidermis. The body is not immediately conscious of the effects of Hertzian, ultra-violet, X- and gamma rays. A latent period of two or three weeks follows exposure to X-or gamma rays before erythema of the skin and irritation result. With ultra-violet rays the latent period is limited to hours. The ultra-violet rays with the maximal power of producing, erythema have a wave-length of 300-290 millimicrons, just that region of the ultra-violet spectrum which comes through with the high sun on clear days. They penetrate no further than the deeper epidermic cells. In them, when absorbed they produce profound atomic changes in in the bioplasm—the tissue cells—followed by chemical changes which cause such a degree of irritation as to tend to dilatation of the subcutaneous blood vessels, exudation of lymph, increase of lymphocytes, and rise in the bactericidal power of the blood.

PROGRESS IN ASTRONOMY.

On May 30th 1930 at the Municipal College Portsmouth, a lecture was delivered on this subject in connection with the Congress of South-Eastern Union of Scientific Societies by Mr. L. B. Benny, M.A., Principal of the Portsmouth College and a Fellow of the *Royal Astronomical Society*. He gave a concise survey of the story of astronomy from the ancien period to the telescopic period with references to the spectroscopic or modern period embracing the research of the present day.

Mr. Benny referred to ancient speculation that was based upon the supposition that the earth was the centre of the universe and that the purpose of the heavenly bodies was solely to minister to its inhabitants. Any suggestion that the earth was not the centre of the universe was regarded as heresay, and punished accordingly. The discovery of the telescope, he said, was an epoch-making event, and practically all the progress made from the time of Newton to the middle of the nineteenth century was directly due to the steady improvement in the power and accuracy of telescopes, and side by side with observational knowledge theoretical knowledge had also grown. During later decades photography had become an increasingly important adjunct to astronomy.

THE ROTATION OF THE GALAXY.

Professor Sir A. S. Eddington delivered the Halley Lecture at Oxford on May 31, on "The Rotation of the Galaxy."

Four leading peculiarities in the motions of the stars had, he said, been noticed. The discovery of Professor J. H. Oort, of Leyden seemed to indicate rotation of the galaxy. He pointed out the analogy between Saturn's rings in which it was found, as was anticipated theoretically, that the inner part of the ring revolves faster than the outer. Similarly it might be expected that in the galaxy the inner stars would revolve round the centre faster than the outer. The actual rotation would be very difficult to detect, but this differential effect between stars nearer and farther from the centre appeared to be plainly manifested by all classes of distant objects. The centre of the galaxy appeared to be situated in or behind the great star-clouds in the constellation Sagittarius. The velocity of rotation of our neighbourhood was roughly determined as 200-300 kilometres a second. Our distance from the centre was 20,000 to 40,000 light years.

We had thus to recognise that for a broad cosmical survey the standard of rest to which we had been in the habit of referring all our measured velocities was a very local one. We had realised that it was too crude to take the sun as standard, and had referred velocities to the "mean of the stars" in our neighbourhood; now we had to apply a further correction of 200 or 300 kilometres a second to reduce to the centre of our galaxy. He was afraid it was too much to hope that this would be allowed to remain a final resting place; outside our own galaxy there were thousands of others (spiral nebulæ) which would claim a share in defining a universal standard.

It had been remarked that stars of very high velocity appeared to move always towards one hemisphere of the sky. It was now found that this direction was opposite to that of the orbital motion; that was to say, we found stars with a large velocity, but not with a large velocity added on to it. The reason for this was now clear; the addition would make the total velocity too gif, and such stars, if they ever existed, would escape from the galaxy altogether.

It had been shown by Dr. J. S. Plaskett, of the Dominion Observatory, British Columbia, that the cloud of diffuse matter which filled interstellar space showed the same rotation as the stars. This gave rise to a difficult dynamical problem, because we should hardly have expected them to behave in the same way. We ofter treated the stellar system as a glorified gas, with the stars for molecules. But whereas the viscosity of the interstellar cloud was quite negligible, it was very large for the stars. Regarded as a gas, the stellar system was the stickiest mess you could ever imagine.

Proceedings and Notices of Societies

THE CHEMICAL SOCIETY.

Thursday, June 5.

The Influence of a Soluble Fluoride on the Corrosion of Iron. By A. W. Chapman.

The behaviour of iron foil immersed in solutions of potassium fluoride, alone and with the addition of sodium carbonate or potassium chromate, has been studied.

In concentrations of less than 0.8*N* there was no appreciable difference in the amount of corrosion caused by corresponding solutions of potassium fluoride and potassium chloride, but above this concentration potassium fluoride acted as an inhibitor of corrosion, the protection which it afforded being broken down by the addition of small quantities of chloride.

Fluoride ions penetrated the protective films formed on the metal by sodium carbonate and potassium chromate less readily than chloride ions.

An unusual corrosion phenomenon which occurred in mixed solutions of potassium fluoride and chromate within certain limits of concentration is described. The cause of this and of the inhibition in fluoride solutious is discussed.

The Application of a New Type of Triode Valve to the Determination of Hydrogen Ion Concentration with Glass Electrodes. By G. B. Harrison.

A new design of triode valve having extremely small grid current is used for the measurement of the *E.M.F.* across the glass membrane in the ordinary glass electrode apparatus for determination of hydrogen-ion concentration. A special type of glass bulb employing a special glass is used. An accuracy of 0.02 pH unit is easily obtained for a single reading, and great robustness and simplicity of operation is claimed. The apparatus is accurate enough for research purposes, and is at the same time suitable for routine testing in works practice.

Properties of Conjugated Compounds. Part X.—Variability in the Mode of Ester-Addition to Butadiene Esters and Ketones. By E. H. Farmer and T. N. Mehta.

The search for evidence not only that butadiene esters and ketones may add the components of ester-addenda at $\alpha\beta$- and $\alpha\delta$-positions in the butadiene chain (one or other in each instance), but also that there is a general tendency, subject to polar influences, for *both* types of addition to occur *simultaneously*, has been successful to the extent that sorbic ester and γ-methylsorbic ester are now known to yield both $\alpha\beta$- and $\alpha\delta$-additive products. In the former instance, which has previously been studied (Farmer and Healey, *J.*, 1927, 1060), an approximation to the $\alpha\beta$, $\alpha\delta$-ratio has been possible by estimating the amount of β-propylglutaric anhydride derivable from a weighed amount of the reduced additive product.

Certain considerations germane to the study of ester addition—the specific reactivity of conjugated esters, cyclisation of additive products, the effect of experimental conditions and the limited usefulness of ozonolysis technique—are briefly dealt with. It is evident from the results described that the evidence relating to β-vinylacrylic ester and certain other conjugated esters and ketones needs supplementing.

GEOLOGICAL SOCIETY OF LONDON.

May 14.

Prof. E. J. Garwood, M.A., Sc.D., F.R.S., President, in the chair.

The following communication was read: *The Geology of North-Eastern British Somaliland.* By Charles Barrington Brown, M.C., M.A., A.R.S.M., F.G.S.

The Author recently accompanied the Anglo-Italian Boundary Commission in Somaliland, and this paper summarises the geological results of four months' field work.

The area discussed is a belt of country along the 49th meridian east, from the coast to about 80 miles inland.

There are three structural units:— (1) The sunken block or belt of the Aden Gulf: this is partly submerged and partly land which forms the low-lying coastal belt. It is bordered on the south by an important fault of 6000 feet throw, from the next unit (2) the faulted upraised mass of the Al Hills, which reach to over 7000 feet, and continue as a bordering scarp along the south of the Gulf as the Aroru and Afaf Hills; on the south succeeds (3) the inland plateau-region at 2000 to 3500 feet elevation. This plateau is entirely unfaulted, but has been subjected to folding of a peculiar kind, resulting in gently undulating areas, unaffected areas, and numbers of small synclinal basins the origin of which is obscure. Possible causes, as deposition of sediments on an uneven floor, collapse along short lines or points by removal of supports, and simple folding, are discussed. The longer axis, generally less than a mile in length, has in most cases a north-west to south-east orientation.

Rocks of several systems occur:—(1) the oldest, the Inda Ad Slates described by Farquharson, may be of Palæozoic age, but no fossils were found: a large boss of granite is reported; (2) Jurassic: 1850 feet of limestones and sandstones resting on the Inda Ad Series, containing a rich fauna at one horizan of Bathonian-Bajocian age, and at another horizon *Belemnopsis tanganensis* of Kimmeridgian age; (3) Cretaceous limestones 1450 feet thick, yielding Holcodiscid ammonites of Barremian age, and higher up, *Orbitolone*, *Ostrea* (*Lopha*) *dichotoma* Bayle, and *Exogyra overwegi* L. von Buch, indicating a Senonian age; (4) Middle and Lower Eocene: 2600 feet of limestones with an anhydrite-bed and some thin clays; sandstone is entirely absent. There are many fossils throughout, but they are especially numerous in the Middle Eocene above the anhydrite; echinoids and nummulites are the predominant types; (5) Upper Tertiary: *Ostrea* (*Lopha*) *folium* Linné and *Chlamys* (*Æquipecten*) *pallium* Linné.

May 28.

The Post-Glacial Deposits of the Lincolnshire Coast. By Prof. Henry Hurd Swinnerton, D.Sc., F.G.S.

The clays which underlie the Lincolnshire marshland crop out between the tide-lines along the coast, and many temporary exposures have been examined in the vicinity of Chapel St. Leonards and Ingoldmells. These deposits lie upon an uneven floor of boulder-clay, and may be divided into Lower, Middle, and Upper Series, separated by well-defined erosion-surfaces.

The Lower Series consists of peat enclosing remains of oak, alder, and birth. It was formed during Neolithic times, when the area must have been at least 20 feet above its present level.

The middle Series consists almost entirely of purple and grey buttery clays, and rests upon an eroded surface of boulder-clay and peat. It is usually 7 feet thick, and is divisible into lower and upper portions by a marked difference in the contained flora: the former, which makes up the greater part of the series, contains a salt-marsh flora including abundant remains of

Posidonia, a form now confined to warmer latitudes; the latter contains a freshwater marsh flora. The upper boundary of this series is defined by a thin peat upon wrich, in teh neighbourhood of Ingoldmells, rest heaps of débris derived from late Bronze Age (and possible early Iron Age) salt-workings.

The Upper Series consists of grey, purple, and black sloppy clays, with numerous *Scrobicularia* and *Cardium* in their lowest portions. They rest upon a deeply eroded surface made up of all divisions of the underlying deposits.

NOTICES OF BOOKS.

The Aluminum Industry. By J. D. Edwards, F. C. Frary and Z. Jeffries, with the collaboration of a group of experts from the staff of the Aluminum Company of America. This is in two volumes, of 358 and 870 pages, respectively. Vol. I deals with Aluminum and its production, Vol. II with Aluminum products and their fabrication. Published by McGraw-Hill Publishing Co., Ltd., 6 and 8 Bouverie Street, London, E.C.4. 1930. Price complete, £3 net.

This book represents one of the most important additions to the literature of non-ferrous metallurgy; and being prepared by experts it is a very comprehensive treatise.

In Vol. I the first chapter deals with the history of aluminum followed by a chapter dealing with the aluminum industry of Europe. Chapter IV covers the uses of aluminum, Chapter V the production of alumina, Chapter VI process for extraction of alumina, Chapter VII furnaces for the production of alumina, Chapter VIII materials for the reduction process and electrodes, Chapter IX production of aluminum. These chapters are by various experts as are those to follow.

In Vol II Chapter I deals with the commercial history of almuinum, Chapter II the physical and chemical properties of aluminum covering 37 pages. The ground covered here seems complete. The table of thermal conductivity occupies nearly two pages. The heat of combustion of this metal follows :— 386,988; 380,200; 392,610; 375,800; 380,800, the last being by Roth in 1928. The formula is, of course, $2Al+3O=Al_2O_3$ calories per mol.

Electrical resistivity receives ample treatment. The mass value for aluminum of high purity is 0.0720 ohm per metre gram at 20° C. The constant mass temperature coefficient of resistivity is 0.00425. We give here the condensed table of the properties of this metal.

Condensed Table of Properties of Aluminum.

Property.	Value.
Atomic weight	26.97
Atomic volume	10.0
Density (grams per cubic centimeter) at 20°C	2.70
Density (grams per cubic centimeter) liquid, at 700°C	2.37
Weight per cubic foot (lb.)	168.6
Compressibility (percentage change in volume per megabar pressure	1.40×10^{-6}
Thermal expansivity, 20 to 100° C.	23.8×10^{-6}
Specific heat, 0 to 100°	0.226
Melting point, degrees Centigrade	660
Boiling point, degrees Centigrade	1800
Thermal conductivity (cal. /cm.^{2}/cm./-°C./sec.) 0 to 100° C.	0.50
Latent heat of fusion (calories per gram)	93
Heat content of liquid at the freezing point (calories per gram)	252.6
Vapour pressure (millimeters) at 730° C.	0.001
Heat of combustion ($2Al+3O=Al_2O_3$) calories per mol.	380,000
Electrical resistivity, commercial conductors microohms per cm.^{3}) at 20° C.	2.83
Resistance temperature coefficient, at 20° C.	0.00403
Solidification shrinkage, percentage	6.6
Reflectivity (percentage for white light)	85
Magnetic susceptibility (c.g.s. units)	0.58×10^{-6}
Electrode potential at 25°C. (volts)	−1.69
Electrochemical equivalent grams per ampere-hour	0.3354

Chapter III deals with the constitution and structure of aluminum alloy systems which is most important. Chapter IV refers to the properties of aluminum alloys, Chapter V commercial alloys, Chapter VI melting, Chapter VII casting, includ-

ing alloys. This is a most important feature and the book will be worth purchasing for this chapter alone. Chapter VIII deals with the working of aluminum which is of great technical interest and commercial value. This chapter includes machining and threading by means of tape. Cutting mixtures of paraffin oil, such as used in machining brass are satisfactory. Chromium plated tools are mentioned as having some advantage, but tungsten carbide tools show superiority in this respect. For the best results to be obtained attention in these cases must be paid to the top rake, side rake and clearances on the cutting edges. Chapter IX deals with cold working and physical properties, Chapter X heat treatment, Chapter XI joining processes, Chapter XII coating and finishing. Electroplating is given a space of seven pages. Chapter XIII deals with the products and their uses, Chapter XIV uses of aluminum in its varied aspects, Chapter XV refers to the design of aluminum structures, Chapter XVI aluminum in transportation. Passenger coaches are illustrated. A complete aluminum-alloy aeroplane propeller is shown on page 646. This metal enters into Diesel engine and locomotive construction. Chapter VII deals with electrical conductors of aluminum, Chapter XVIII this metal in the electrical industry Aluminum rectifiers are treated at some length with diagrams, then follow lightning arresters. Chapter XIX deals with aluminum in the food industries, Chapter XX this metal in the chemical industries, Chapter XXI metallurgical uses of aluminum, chapter XXII aluminum paint, and last but not least the future of aluminum. A number of appendixes follow. In both volumes there are name and subject indexes and a list of works is given in Vol I, p.336.

The thoroughness of this work recommends it to all seriously interested in aluminum and at the price the two volumes are cheap.

Sodium Oxalate as a Standard in Volumetric Analysis. Circular of the Bureau of Standards (U.S.A.) No. 381. P. 9. 1930. Sold by the Sup. of Documents, Washington D.C. U.S.A., price 5 cents.

In order to bring to date the information on the standardisation of solutions by means of sodium oxalate, Bureau of Standards Circular No. 40 (now circular No 381), Sodium Oxalate as a Standard in Volumetric Analysis, has been revised. This was done in connection with the analysis of the new lot of sodium oxalate No. 40c which is to replace the present sample No. 40b. Some new tests for purity and data on the effect of rapid titration are given. The contents are as follows :—

- Preparation of sodium oxalate.
- Purification.
- Reproducibility.
- Testing of sodium oxalate.
- Special tests.
    - Water.
    - Neutrality.
    - Insoluble matter.
    - Sulphate.
    - Chloride.
    - Oxides of iron, aluminium, etc.
    - Potassium.
    - Organic impurity.
- Stability of sodium oxalate.
- Preservation in the dry state.
- Hygroscopic properties.
- Temperature of decomposition.
- Stability of stock solutions.
- Uses of sodium oxalate.
- Oxidimetry.
- Conditions for standardisation.
- Precision.
- Absolute accuracy.
- Acidimetry.

Periodisches System: Geschrite und Theorie. By DR. E. RABINOWITSCH AND DR. E. THILO. Pp. XII + 302. Published by Ferdinand Enke, Stuttgart. 1930.

This book is divided into five main sections as follows :—History of the Natural System of the Elements; Constitutents of the Atom; Atom Model; Construction of the Periodic System; Periodicity of Chemical Properties.

Passing over the historical introduction, which is brought up to date, of particular interest is the development of the periodic classification of the elements. It will suffice to mention the names and dates here :—J. B. Döberinier, 1780-1849; M. Pettenkofer, 1818-1901; W. Odling, 1829; and J. H. Gladstone, 1827-1902; J. A. Newlands, 1865; B. de Chancourtois, 1863; Mendelejeff, 1834-1907; and Meyer, 1830-1895. Meyer's table of 1870 is given in juxtaposition to Mendeleieff's one of 1871; but priar to these Odling's table of 1857 is placed opposite to one by Newlands of 1865, and one by Meyer, 1868, can be compared with one by Mendelejeff of 1869 and a later one by the latter of 1871. The Jul. Thomson and N. Bohr table is given on page 44.

The tabular treatment is of a high order characteristic of German work and on page 86 is given an up-to-date table of the radioactive elements which is of interest,

but the final dispositions at the beginning of the uranium-actinum series is not possible as is indicated.

The treatment on the whole is very comprehensive, but certain omissions have been necessary in order to keep the book within the limit prescribed by only 302 pages.

Some of the tables are of special interest as may be indicated, for example, by one giving the ionisation potentials of the elements on page 257, and another giving the ionic radii on page 272.

Aston's recent work is given and his packing-fraction scheme fully reproduced.

This book will form a useful companion volume to some of the more complete works as the authors have stressed certain features which make the treatment of value.

The names require revising; for example, Russel appears several times when H. N. Russell is referrel to. It would be better to have given the full initials in all cases. The references (p. 12) in connection with illinium are not complete. These are perhaps minor matters.

HOW FARADAY SECURED CONVICTION OF PUBLICAN.

Extensive preparations are now taking place in connection with the Faraday Centenary. In 1830 Faraday, who was then President of the Royal Institution, was at times requisitioned to give evidence on behalf of several Government departments. In June of that year one, Mr. John Gibbon, of the Three Tuns, Rupert Street, Haymarket, was charged before the Board of Excise with adulterating his porter. Mr. Michael Faraday, the famous chemist and director of the Royal Institution, stated that he had analysed the porter and discovered in it sulphate of iron, sodium chloride, and other foreign matters. Gibbon was fined £70.

Forthcoming Events

THE ROYAL SOCIETY.

Thursday, June 19, at 4.30 p.m.—The following papers will probably be read :—

" New Results of the Magnetic Spectroscopy of X-ray Electrons." By H. R. Robinson, F.R.S., and C. L. Young.

" Photo-Conductance Phenomena in the Silver Halides and Latent Photographic Image." By F. C. Toy and C. B. Harrison. Communicated by T. Slater Price, F.R.S.

" The Optical Determination of High Metallurgical Temperatures. The Melting Point of Iron." By C. H. M. Jenkins and M. L. V. Guyler. Communicated by W. Rosenhain, F.R.S.

ROYAL STATISTICAL SOCIETY.

The Ninety-sixth Annual General Meeting will be held in the Hall of the Royal Society of Arts, John Street, Adelphi, on Tuesday, the 17th day of June, 1930, at 5 p.m. Agenda—To receive the Report of the Council for the past year; To elect the President, Council, and Officers for the year 1930-31.

" RESTORED " GERMAN PATENTS.

Under date May 17, the Board of Trade have made an Order revoking their Order of July 19, 1920 (S.R. & O., 1920, No. 1336), which imposed certain conditions and restrictions upon dealings in " restored " German patents.

The effect of this Order is to render it unnecessary in the future to obtain the consent of the Board of Trade to any dealings in such patents.

The Order also preserves any existing licences or assignments under these patents which may have been granted or approved under the " War " or Treaty of Peace legislation, but any royalties or other sums hitherto payable to the Controller of the Clearing Office and accruing from May 17 may be paid to the patentee.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

15,493.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of meta-hydroxy-diarylamine-carboxylic acids. May 20.

15,627.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of vat dyestuffs. May 21.

15,636.—I. G. Farbenindustrie Akt. Ges. —Manufacture of arylides of aromatic hydroxy-carboxylic acids. May 21.

Specifications Published.

329,357.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of derivatives of pyranthrone.

329,364.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of vat dyestuffs.

329,375.—I. G. Farbenindustrie Akt.-Ges. —Manufacture and production of pure benzoic acid.

329,427.—Hercules Powder Co.—Method of producing nitric acid.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

PYRETHEX.

511,735.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—The Strawson Chemical Co., Ltd., 79, Queen Victoria Street, London, E.C.4. May 28th. (Associated.)

ENGINALITIES.

511,632.—Chemical substances used in manufactures and anti-corrosives. —W. H. Willcox & Co., Ltd., 38, Southwark Street, London, S.E.1. May 28th. (Associated.)

CALVAP.

512,195.—Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes.—F. C. Calvert & Co., Ltd., Tower Chemical Works, Gibbon Street, Bradford, Manchester. May 28th (Associated.)

CALVEX.

512,196.—Chemical substances used for agricultural, horticultural, veterinand sanitary purposes.—F. C. Calvert & Co., Ltd., Tower Chemical Works, Gibbon Street, Bradford, Manchester. May 28th (Associated.)

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NOTICE TO AUTHORS & CORRESPONDENTS.

Contributions for publication either as original articles or in the correspondence columns are welcomed by the Editor of *The Chemical News*.

They must be accompanied by the contributors' full names and addresses, not necessarily for publication, but as an indication of good faith. If a reply is needed or if it is desired that a manuscript which is not accepted for publication be returned, a stamped addressed envelope should be enclosed.

No notice can be taken of anonymous letters.

THE SEPARATION AND DETECTION OF OXALATE IN THE PRESENCE OF OTHER REDUCING ACIDS.

By L. J. CURTMAN AND S. M. EDMONDS.

The general method of separating oxalate from other reducing acids, particularly tartrate, is based upon the insolubility of calcium oxalate in dilute acetic acid. Experiments, however, showed that when the amount of tartrate is large, a concentration of acetic acid of at least four per cent. is necessary to prevent calcium tartrate from precipitating. With this concentration of acid the precipitation of small amounts of calcium oxalate proved very slow and incomplete. For the rapid estimation of small amounts of oxalate the acetic acid separation is thus unsatisfactory. By means of a rather lengthy procedure, Bau* has shown that in boric acid solution very small amounts of calcium oxalate may be completely precipitated in the presence of large amounts of tartrate. It was the purpose of this work to develop a method, based on the observations of Bau, which would be applicable to the rapid separation and estimation of oxalate in the presence of all the common reducing acids.

Experiments indicated that in a solution just acid with acetic acid and containing four per cent. of boric acid, none of the reducing acide save oxalate precipitated on the addition of calcium chloride solution. The results of these experiments and numerous test analyses led to the following procedure.

Procedure.

If fluoride is present, see Note 1. Acidify 3 cc. of the prepared solution (Note 2) with 6 *N* acetic acid. If ferrocyanide is known to be present, add 5 cc. of 3 per cent. hydrogen peroxide (Note 3). Dilute with water to 50 cc. Add 2 g. of boric acid and heat with stirring until it is dissolved. Cool thoroughly. Add dropwise and with stirring, 2 cc. of 2 *N* calcium chloride solution and allow the mixture to stand for 10 minutes, stirring frequently (Note 4). If a precipitate forms and fluoride is absent, the probable presence of oxalate is indicated. If no precipitate forms within ten minutes, then oxalate, in amounts greater than 3-4 mgs., is absent. Heat to boiling, boil for one minute and filter. Wash the precipitate with hot water until a small test portion shows the absence of reducing substances (Note 5). Treat the residue on the filter twice with small portions of hot dilute

* *Chem. Zeit.*, 1918, xlii, 425.

H_2SO_4. Wash once with hot water and unite the aqueous with the sulphuric acid extracts. Heat the solution almost to boiling and titrate with *0.1 N $KMnO_4$. Bleaching* of the permanganate shows the presence of oxalate.

NOTES.

1.—*In the presence of fluoride*, the procedure must be altered slightly, since calcium fluoride and oxalate, especially when the amount of oxalate is small, tend to go into the colloidal state. To obviate this difficulty some calcium sulphate is precipitated along with the fluoride and oxalate. Therefore, acidify 3 cc. of the prepared solution with dilute sulphuric acid. Add 1 cc. in excess and make the solution alkaline with 6 *N* NaOH. The procedure is then to be followed exactly as given, except that it is necessary to add 5 cc. of $CaCl_2$ instead of only 2 cc. Calcium sulphate does not precipitate until the solution is heated.

2.—This solution is made by treating 3 g. of the substance to be analysed with 50 cc. of freshly prepared 3 *N* sodium carbonate solution, boiling for three minutes and filtering. If NH_3 fumes are given off, the boiling should be continued until all the aammonia has been removed. The maximum quantity of acid radical likely to be present in 1 cc. of the prepared solution is 30 mg.

3.—If ferrocyanide is present, a precipitate of ferrocyanic acid forms when the solution is heated to dissolve the boric acid. The precipitate is objectionable since it gives a final positive test with permanganate. The peroxide oxidises the ferrocyanide which does not precipitate when the solution is heated.

4.—The precipitation of calcium oxalate, especially when only small amounts (5 mgs. or less) of oxalate are present, takes place slowly and may not begin until 2-3 minutes have elapsed after the addition of the calcium chloride solution. The precipitation is practically complete in 10 minutes.

5.—Collect 5 cc. of the washings in a test-tube. Add 5 cc. dilute H_2SO_4, heat almost to boiling and add one drop of 0.1 *N* $KMnO_4$. The absence of reducing acids is shown when the drop of permanganate is not bleached.

Test Analyses. In testing the procedure, analyses were made of mixtures containing in 3 cc. 5 mg. of oxalate and 150 mg. of each of the common reducing acids, *viz.*, tartrate, sulphite, thiosulphate, bromide, iodide, thiocyanate, cyanide, ferrocyanide, arsenite and nitrite. Controls, containing 150 mg. of each of the acids were als analysed. In all cases the tests were satis factory.

Effect of Other Acids. Test-analyses wer made in the presence of other acids tha might possibly cause trouble, either by pre venting the precipitation of calcium oxalat or by precipitating along with it and ac sorbing other reducing acids.

Sulphate. Under the conditions of th procedure, $CaSO_4$ does not precipitate in th cold. However, when the solution is heate to boiling and provided that at least 10 mg. of sulphate are present, a voluminou precipitate is thrown down. Test analyse of solutions containing 5 mg. C_2O_4 and 15 mg. SO_4 in 3 cc. showed that the sulphat caused no interference. In addition, mix tures of sulphate and tartrate were als analysed and it was found that the CaSO precipitate could be very easily washed fre of tartrate.

Chromate. No precipitate is formed i the presence of 150 mg. of chromate, eithe in the cold or on heating to boiling. Analy ses of test and control solutions were sati factory.

Phosphate. With the maximum amoun of PO_4 present, no precipitate is obtaine until the solution is brought to boilin No difficulty was encountered in detectin 5 mg. C_2O_4 in the presence of 150 mg. phosphate. In the presence of $C_4H_4O_6$ the is some adsorption although from 5-6 was ings proved sufficient to remove all trace Controls were in all cases satisfactory.

Fluoride. Calcium fluoride precipitat immediately on addition of the $CaCl_2$ sol tion. It was found, however, that wi small amounts of oxalate no CaC_2O_4 precip tated. These results agree with the observ tions of A. Mazzuchelli and D. Vita† w showed that, when calcium chloride sol tion is added to dilute (ca 0.04 *N*) mixtu of fluoride and oxalate, no precipitate is o tained but instead a fairly stable colloid solution forms. This difficulty was ov come by precipitating calcium sulpha along with the fluoride and oxalate. In t way most of the oxalate, even when or 5 mg. were present, could be precipitat and detected.

Ammonium Salts. The effect of N salts on the precipitation of CaC_2O_4 marked only if the amount of oxala present is 5 mg. or less. In this case, it w found that precipitation was delayed fr 10 to 25 minutes after the addition of t calcium chloride solution. However, a

† *Gazz. chim. ital.*, 1920, L, *1*, 232.

monium salts should not be present, since in the analysis, a prepared solution is used.

SUMMARY.

A rapid method has been devised for the separation and detection of oxalate in the presence of all the common reducing acids; it is based upon the insolubility of calcium oxalate in boric acid. Numerous test-analyses have shown the method to be trustworthy.

College of the City of New York.
New York City.

SOCIETY OF CHEMICAL INDUSTRY.

For the first time for more than twenty years the Society of Chemical Industry will hold its Full Annual General Meeting and Congress at Birmingham. This will take place throughout the week beginning July 14th, under the Presidency of Dr. Herbert Levinstein.

Besides the usual ceremonies associated with the Meeting the programme will include visits to various works, among them being those of Messrs. Cadbury Bros. at Bournville, and Messrs. W. & T. Avery Ltd. at Soho Foundry.

The Messel lecture will be delivered by Lord Brotherton, this year's recipient of the coveted Messel Medal, the Society's award for services to the chemical industry.

Amongst previous holders of the Messel Medal have been the late Lord Leverhulm and the late Lord Balfour.

The Society of Chemical Industry is the largest professional body of industrial Chemists in the world. Its membership now exceeds 5000, and includes chemists from many countries.

During the Meeting the election of Lord Melchett as next year's President of the Society will be confirmed.

CHEMICAL FIRM'S EXHIBIT.

A highly interesting exhibit is being prepared by Burroughs Wellcome & Co., at the Ideal Holidays Exhibition, to be opened by H.H. Princess Marie Louise on Friday, June 20th, at the Royal Agricultural Hall, London, N.1., and to remain open until July 3rd. Messrs Burroughs Wellcome & Co. are making special displays of their famous Tabloid outfits for travellers of every kind and in every country, whether Arctic or Tropical, and as a practical illustration of the benefit of their goods are showing the medical cases used by famous explorers. Dioramas showing scenes from explorations lend special interest to a display of high value.

NOTES ON HOP-DRYING IN THE SAAZ AND HALLERTAU DISTRICTS.

By A. H. BURGESS, B.Sc.

(Institute of Brewing Research, abstracted from the *Journal of the Institute of Brewing*, March, 1930.)

The experiments which have been carried out at the Experimental Kilns of the Institute of Brewing, have given results which show that the type of hop-drying kiln in general use in this country is not that which can be expected to give the most satisfactory results. It was with the object of comparing the English method with the methods used in famous centres as Saaz (Czechoslovakia) and Hallertau (Bavaria) that the Institute of Brewing arranged for a visit to these districts .

In both centres the old practice of drying without artificial heat appears now to have been entirely abandoned.

In the Saaz district the kilns are all based on the same principle. The hops are loaded, to a depth of about four inches, on a kiln floor composed of long perforated iron plates, about nine inches wide by ten feet long, which are pivoted longitudinally at their centres. After about one hour's drying these plates are tilted into a vertical position by means of a handle, attached to levers, operated from outside the kiln; this allows the hops to fall a distance of about two feet on to a similar floor of plates below. The top plates are then reloaded with green hops and, after an interval of about an hour, the hops are again moved downwards; the first load falls on to a third floor of plates and the second load falls on to the floor thus cleared; a fresh load is again placed on the top floor. After another hour the hops are once more moved downwards and the top floor reloaded; the hops from the lowest plates this time fall into drawers with perforated iron bottoms, these form the lowermost floor of the kiln. After remaining in the drawer for a further hour, the hops are sufficiently dry; they are then withdrawn, in the drawers, through long flap-like doors in the kiln wall. The drawers are fitted with small wheels which run on rails and are therefore easily removed from the kiln. The whole process, from loading to removal, takes about four hours.

The dried hops remain for about eight hours in a shallow ridged heap; they are then placed in a deeper heap and turned occasionally. When it is desired to market the hops they are loosely packed, by treading, into large pockets in which they are taken to the Marking Hall for sealing.

The air in the kiln is generally heated by means of a closed fire, of the "Cockle" type. The draught is, in most cases, naturally produced, the kilns being built high—from thirteen to twenty-six feet between heater and lowest floor—to promote a good draught; occasionally, however, fans are employed.

Hops for export or storage again undergo slight drying during the sulphuring process; this is carried out by the hop preparing station, or merchant to whom they are sent.

The fuel consumption is about the same as in our ordinary open fired kilns—about 1 cwt. of coal for 1 cwt. dry hops—the coal used, however, is of a soft brown type and possibly has not the same calorific value as the anthracite used in England.

The temperature of the drying air is, in general, kept comparatively low—in the region of 100° F. between the top and second floor. Some growers stated, however, that when fans were employed it was possible to use a somewhat higher temperature; in this case the hops needed only about three hours to dry. The control of temperature is not practised to the same extent as it is in England and thermometers are usually of a simple type; the long stemmed transmitting thermometers, such as are now so commonly used in this country for hop-drying, did not appear to be used.

The "Linhart" type of kiln which is described above appears to have been evolved from an older type, the "Löschner"; in this system, instead of the floors of tilting plates, drawers with perforated bottoms are employed for all the four superimposed drying floors.

A more modern outcome of the "Linhart" system is known as the Saazia." In this system the floors of plates and the lowest floor of drawers is the same as in the "Linhart," but the hot air does not pass directly up from the heater through the hops. The lower part of the kiln containing the heater is completely divided, by means of a brick or concrete ceiling, from the upper part which contains the drying floors. The heated air is led into flues, which extend the whole width of two sides of the kiln. This hot air may be admitted beneath any, or all, of the four layers of hops, through rows of apertures in the walls; these apertures are covered, or uncovered to the desired extent, by means of slides controlled from the outside of the kiln. The heaters used in this kiln are of a "Cockle" type and are automatically fed with brown coal by means of a hopper arrangement. Some kilns of this type depend on natural draught, others are fitted with an electric fan above the uppermost floor of hops. The time of drying with the "Saazia" kiln is about four hours, as with the "Linhart." It possesses an advantage over the "Linhart" in that the amount of hot air supplied to each floor can easily be regulated; it is, however, more complicated in design and more expensive to erect than the "Linhart."

Another system, the "Elektra," differs from the ordinary "Linhart" in being fitted with a fan which is placed in a duct above an open-fire air heater and below the hops. Coke is used as fuel. (This was the only open fired kiln which we saw). Only two floors of tilting trays were used above the drawers in this kiln.

The opportunity was taken to visit a number of hop gardens; among these were those attached to the Agricultural Institute at Saaz and the Experimental Hop Garden of the German Section of the Hop Growers' Association, at Tuchorschitz. It was most interesting to compare the methods of culture, training and picking with those of this country.

We then visited the Hallertau district which is the largest hop-growing area in Germany. The systems of drying in use in this district are either the "Linhart" or are dependent on the same prnciple as the "Linhart" which has already been described. A few of the old "Hallertau" kilns still remain in use; these are similar to the English "Cockle" kiln.

At the Hop Research Station, at Hüll, a new kiln had just been erected. The growers in Hallertau usually cultivate only small areas of hops and their oasts generally consist of a single small "Linhart" kiln. In going through the district many hop gardens, including that of the Research Station, were visited; picking was in progress in most of the gardens. A new large hop-preparing station and store was also inspected. These hop-preparing stations contain kilns, resembling ordinary English kilns; the floors however, are composed of stout steel wires. The dried hops, sent in by the growers, are treated with sulphur in the kilns and packed for market.

MANUFACTURE AND PROPERTIES OF A CELLULOSE PRODUCT (MAIZOLITH) FROM CORNSTALKS AND CORNCOBS.

By C. E. Hartford.
(*U.S. Bureau of Standards.*)

Maizolith is a dense, hard, bonelike substance made by cooking cornstalks or corncobs with caustic soda, washing the residue, beating it to a jelly, and drying. The finished product has a modulus of rupture of about 16,000 lbs.in.^{2} and a volume resistivity of 3×10^9 ohms/cm^3. It is practically unaffected by oil, but becomes soft on prolonged soaking in water.

The optimum conditions for the manufacture of maizolith were found to be those indicated by the following process: Digest the shredded cornstalks three hours at 40 pounds pressure with 10 per cent. of their bone-dry weight of caustic soda; dilute to a 1 per cent. solution; wash free of cook liquors; dilute the pulp to a consistency of 4 per cent., beat for two hours in a combined beating engine and Jordan refiner, and dry at a temperature of 70° C.

Cost figures for the process indicate that in a plant large enough to produce 5 tons per day, finished maizolith can be made for about $240 per ton, using cornstalks as the base material.

Maizolith could probably be made at a lower figure than $240 per ton as a by-product of the insulating wall board industry, by utilising fibres or pith particles which are too fine or too highly hydrated to be used in insulating board.

By utilising the soft residue from the process of extracting adhesive material from corncobs maizolith could probably be produced at a lower figure than that from either of the processes outlined above.

Maizolith as a By-Product from other Industries.

In the process of making an insulating wall board from cornstalks, it may be necessary before forming the board to remove the fibres which are smaller than a certain size. If this is the case these small fibres would make an excellent raw material for the manufacture of maizolith. Experiments conducted at the experimental insulating board plant at Ames indicate that a plant producing 50,000 square feet of insulating board per day would furnish enough fine material to make 8,000 pounds of maizolith per day. This fine material would be put through the same process as that outlined above for the cornstalks, except that instead of being passed through the shredder they would be run through a filter and then to the digester. This modification of the process would then reduce the cost of the raw material and the shredding and add the expense of filtering and hence make the total cost less than that outlined above.

The process of extracting an adhesive material from corncobs is one which gives promise of soon becoming commercial. In this process corncobs are steam digested for a short time. The liquor which is drained off shows good adhesive properties when concentrated. This treatment leaves 55 per cent. of the cob as a soft residue, in ideal condition for conversion into maizolith. This process would be the cheapest of the three, since the cost of raw material and beating would be reduced, and expense of the shredding eliminated.

Since the demand for a low-priced material which combines strength, hardness, and electrical insulating properties is continually increasing, it seems probable that maizolith, which can be produced cheaply, and which has the desired properties, may soon play an important part in supplying this need.

SULPHURIC ACID MANUFACTURE IN CANADA.

The rapid development of the mining industries in Canada, and the necessity which is experienced for the conversion into commercial products of the dangerous fumes emitted by metallurgical smelters, is resulting in a large increase in sulphuric acid manufacture in the Dominion.

The expansion now in progress has not yet revealed itself to any appreciable extent in the statistics of production, though those for the current year will no doubt record the production of much of the new plant now about to come into operation.

According to a statement just issued by the Dominion Bureau of Statistics at Ottawa, there was a considerable increase in 1929 in the production of 66 degrees Béaume sulphuric acid, the quantity turned out being 110,749 tons valued at $1,375,599. The output in 1928 reached 96,227 tons, worth $91,634 in 1929 as against 13,329 tons, worth $152,544 in the previous year; practically all of the acid was sent to the United States. Imports totalled only 111 tons, worth $10,287 in 1929 and 55 tons worth $8,652 in 1928.

Only 7 plants in Canada made sulphuric acid in 1929. These concerns used 10,461 tons of pyrites and 25,978 tons of suphur, while two made sulphuric acid from waste smelter gases.

JUBILEE EXHIBITION OF BOHEMIAN GLASS.

The Bohemian glass industry was founded in the 17th century and rapidly attained to some importance in the Iser and Sazava valleys. There is now in progress at Zelezny Brod, one of the chief centres of the Czechoslovak glass industry, an exhibition of glassware. The chemical glassware, a familiar product in all laboratories, comes chiefly from Sazava where wood is still partly used as fuel. An idea of the extent of the industry may be gathered from the production figures for blown glass :—

Year	Tons	Value in thousand crowns
1922	41,186	403,106
1923	37,197	327,945
1924	51,408	430,661
1925	58,153	527,657
1926	56,188	501,560
1927	60,593	518,615
1928	68,756	571,592
1929	68,713	583,192

The figures for plate glass are also rising annually, whilst in addition there is a considerable output of fancy glassware at Jablonec (Gablonz).

The production of plate glass is given in the following table :—

Year	Tons	Value in thousand crowns
1922	32,617	107,023
1923	28,745	71,080
1924	44,074	97,662
1925	50,346	120,946
1926	50,672	135,107
1927	56,706	150,906
1928	69,888	182,617
1929	87,046	221,706

WHOLESALE PRICES IN MAY.

Board of Trade Index Numbers.

As measured at the Board of Trade, wholesale prices in May showed, on balance, a decline of 1.3 per cent. as compared with April, and a decline of 10.2 per cent. as compared with May, 1929, the index numbers for the three months being 78.4, 74.4, and 81.7 respectively (1924=100).

The index numbers shew that the fall in the prices of the items included both in the food groups and in the industrial materials groups has been continued into the first and second halves of May. The recovery in the average of food prices in the latter part of April has not been maintained.

GENERAL NOTES

CHEMICAL INDUSTRIES IN CANADA.

Report for 1929.

The Dominion Bureau of Statistics at Ottawa has forwarded to the Acting High Commissioner for Canada in London its Preliminary Summary Report on Chemical and Allied Products in Canada for 1929, indicating a gain of 14 per cent in production during the last twelve months. The output value of chemicals and allied products in 1929 was $168,598,892, a total higher than that for any previous year except 1917 and 1918, when the production of munitions at war-time priced levels carried the output value to an abnormally high figure. The advance in value last year as compared with 1928 was $21,623,055. The consumption of chemicals and allied products in Canada last year is calculated to have reached $186,902,374, an increase of $21,827,696 as compared with the previous year's total of $18,536,645.

For statistical purposes the producers of chemicals and allied products have been arranged in fifteen groups, namely : acids, alkalies and salts, adhesives, coal tar distillation, compressed gases, explosives, ammunition and fireworks, fertilisers, flavouring extracts, matches, medicinal, pharmaceutical and toilet preparations. paints, pigments and varnishes, polishes and dressings, soaps and washing compounds, wood distillation products, and a miscellaneous group of industries whose products do not naturally fall under any of the preceding headings.

In 1929 gains were recorded in 12 of these 15 main divisions; the exceptions, each showing only a slightly lower total than in 1928, were the coal tar distillation industry, the manufacture of explosives, ammunition and fireworks, and the group specializing in the preparation of polishes and dressings.

In the 549 plants classified as manufacturers of chemicals and related products, the capital employed totalled $172,374,686, or $23.4 millions more than the sum reported by the 572 concerns in this class in 1928, Employees numbered 16,791, or just a few more than in the preceding year; Salaries and wages paid amounted to $22,580,117 as against $20,290,417. Materials used in manufacturing cost $81,326,159 and as the selling value of products reached $168,598,892, the value added by manufacturing, the difference between these two items, was $87,272,733. Comparative data for 1928 showed materials at $74,163,-

334, products at $146,975,837, and value added, $72,812,503.

Ontario and Quebec are the leading provinces in the chemical industry in Canada. In 1929 Ontario plants in this group numbered 292, Quebec stood second with 159; the numbers in the other provinces were: British Columbia, 38; Manitoba, 31; Nova Scotia, 12; New Brunswick, 8; Alberta, 6; and Saskatchewan, 3; making 549 in all.

Imports from the United Kingdom were worth $5,502,453, a gain of $728,274; imports from the United States were valued at $27,403,857; making a gain of $2 millions over the figures for 1928.

Exports to the United Kingdom were valued at $4,729,616 as against $4,348,490 in 1928 and shipments to the United States reached a value of $11,985,642 as against $9,378,994 in the preceding year.

Chemical process industries are well established in Canada and contribute largely to domestic production and export trade. The record of recent years indicates active growth; higher output values show that the industries are expanding and gaining strength. It is interesting to observe that 79 per cent. of Canada's chemical needs are met by Canadian industries.

SECOND INTERNATIONAL CONFERENCE OF BENZOLE PRODUCERS.

The Second International Conference of Benzole Producers met at the Grosvenor House Hotel, Park Lane, W., on May 30, and 31. Delegates from the following countries were present:—

Belgium, Czechoslovakia, France, Germany, Great Britain, Holland, Italy, Poland, Sarre, Spain.

They were received by the President, Sir David Milne Watson, LL.D., D.L., President of The National Benzole Association. The Conference was opened by a speech of welcome by Monsieur H. Laurain, President of the International Conference of Benzole Producers.

Sir David Milne-Watson, in his address, outlined the remarkable progress which had been made in the production of benzole during recent years principally in Great Britain and Germany, and in dealing with he distributing, marketing and propaganda aspects of the position in Great Britain, suggested to the other countries represented that they might form a basis for the exploitation of benzole in their respective

Five important papers were read at the Conference as follows:—

"Motor Fuels for High Compression Engines."

"Resin Formation in Motor Spirits."

"Estimation of Gum in Motor Benzoles."

European Benzole Market Position."

"Sales Organisation."

These were followed by a cinematograph film depicting what had been done to exploit British produced benzole in Great Britain.

A luncheon was held at the Grosvenor House Hotel, at 1 p.m., and was attended by numerous important guests. During the luncheon speeches were given by Sir David Milne-Watson, Monsieur Laurain, Mr. S. Henshaw, F.I.C., Chairman of the National Benzole Company, Ltd., and a number of foreign delegates. The Conference was concluded with a visit to the distribution Depots, Research Stations and various transport workshops of the National Benzole Company, Limited.

ABRASIVES.

Abrasive materials play a most important part in modern industrial and domestic activity. Few, if any, of the materials so widely used in everyday life but what have been subjected to some form of abrasive treatment before being placed on the market. The accurate grinding and honing of engine cylinders so necessary in the production of the modern gasoline engine as used in motor cars or motor boats, or in aeroplanes, is made possible only by the use of suitable abrasives. The final finish on plate glass, motor car bodies and furniture is entirely due to abrasives. Even buffed and suede leathers owe their characteristic surface finish to the carefully applied tearing action of minute particles of an abrasive. Metal polishes for silver, for nickel, or for brass are familiar to everyone.

The great importance of these non-metallic mineral products led the Mineral Resources Division of the Mines Branch to investigate the production and use of abrasive materials in Canada. As a result of those investigations the Mines Branch has recently issued a monograph on abrasives by V. L. Eardley-Wilmot. It was found necessary to subdivide the report into four parts, which have been published separately as follows: Part I No. 678 Siliceous Abrasives; Part II No. 675 Corundum, Emery and Diamond; Part III No. 677 Garnet; and Part IV No. 699 Artificial Abrasives; totalling in all 383 pages and numerous illustrations and diagrams.

This series of valuable monographs describes in considerable detail all the principal deposits of natural abrasive materials in Canada which have been discovered and developed; treats of the characteristics and trade requirements of abrasive products; and describes methods of preparation for markets and the various industrial applications of each material.

Part IV, the final instalment, has just been published and describes in detail the history and manufacture of the artificial abrasives—of which, incidentally, there was in 1929 a record production in Canada of 75,000 tons valued at over seven million dollars. The manufacture of grinding wheels sandpaper, steel wool and other abrasives is described in detail, as well as their principal industrial applications. Although this report contains a very extensive bibliography, nevertheless, much of the detail contained therein has been obtained first-hand and has never been published heretofore.

This complete group of monographs constitutes a very valuable and useful addition to the series of reports on industrial minerals that has been issed by the Mines Branch. Copies of any of the above four parts may be obtained now upon application to the Director, Mines Branch, Department of Mines, Ottawa, Canada.

BOARD OF TRADE ANNOUNCEMENT.

Dyestuffs (Import Regulation) Act, 1920.

Applications for licences in May, 1930.

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during May has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month of May was 720, of which 641 were from merchants or importers. To these should be added 15 cases outstanding on the 30th April, 1930, making a total for the month of 735.

Of the total of 735 applications received, 681 or 93 per cent. were dealt with within seven days of receipt.

BRITISH INDIAN TRADE IN 1929-30.

For the fiscal year ended with March a favourable balance of Rs. 77,17 lakhs is shown, as compared with an excess of exports which amounted to Rs. 84,65 lakhs in the previous twelve months. Merchandise from the United Kingdom totalled Rs. 125,86 crores, against Rs. 137,14 crores in 1928-29. Exports to this country amounted to Rs. 111 crores, against Rs. 115,04 crores.

STORAGE OF NATURAL GAS IN ALBERTA.

The Canadian Western Natural Gas, Light, Heat and Power Company, Limited, of Calgary, has received from the Minister of the Interior at Ottawa an additional reservation of certain lands in the Bow Island area of Alberta, where an attempt is to be made to store surplus natural gas from the Turner Valley Field. The project is to recharge the exhausted sands of the Bow Island natural gas field, and the Order-in-Council published in the official "Canada Gazette" of May 17th states the conditions under which the reservation has been granted for a period no exceeding 20 years. The Bow Island gas sands covered by the permit underlie the available portions of a surface area of approximately 19,440 acres, of which 680 acres have already been acquired under lease. The Company expects to spend more than $500,000 on the project, which has the approval of the Gas Conservation Committee appointed jointly by the Federal and Provincial Governments.

Among the conditions set forth in the Order-in-Council is the requirement that the Company shall commence the actual introduction of gas into the depleted sands not later than May 1st, 1931. The amount of gas to be injected each year to reach not less than 200,000,000 cubic feet until the maximum pressure has been reached and maintained.

The Bow Island gas field, in which the interesting gas storage experiment is to be made, is located about 140 miles southeast of the Turner Valley and a slightly greater distance from Calgary. Prior to becoming depleted it was the principal source of the natural gas supply for the city of Calgary. Now it is proposed to rejuvenate the old wells by bringing gas from Turner Valley, where great quantities are being wasted at the naphtha wells, and to store this gas so that it may be used whenever the peak-loads on the Company's gas lines may require such reserve supplies.

VISIT OF HIS MAJESTY'S TRADE COMMISSIONER AT MELBOURNE, AUSTRALIA.

The Department of Oversea Trade announce that Mr. H. L. Setchell, His Majesty's Trade Commissioner at Melbourne is now in this country on an official visit.

Mr. Setchell will be available at the offices of the Department from 16th to 23rd June to interview manufacturers and merchants interested in the export of British goods to the States of Victoria and South Australia.

He will later visit a number of industrial centres in the Provinces.

Firms desiring interviews with Mr. Setchell in London or information regarding his arrangements to visit provincial centres should apply to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1., quoting the reference 13416/1/30.

ECONOMIC POLICY OF THE MEXICAN GOVERNMENT.

We are advised by the Dept of Overseas Trade that the text of a message addressed by the National Chamber of Commerce to the President of the Republic of Mexico. In this message, the National Chamber of Commerce request the President to approve the putting into effect of the Law creating the National Council of Economy. It is suggested by the Chamber that the Council should represent the opinion of every branch of production and that, as such, the Council should indicate the means of solving the economic crisis through which the country is passing. It is the hope of the Chamber of Commerce that every economic group will be at liberty to be represented on the Council and that the Council may discuss freely every problem submitted to them and reach decisions which will be for the benefit of the majority and of the country as a whole. For this reason the Chamber of Commerce desire that the members of the National Council of Ecouomy shall be genuine representatives of every social-economic group.

In conclusion, it is explained that the motive for this request is the desire of the Chamber of Commerce to co-operate in the reconstruction of Mexico. They consider that the National Council of Economy, by offering technical and dispassionate opinions will be able to afford valuable assistance to the Commission formed by the Minister of Industry, Commerce and Labour for the pur pose of alleviating the conditions of the unemployed and of laying down the bases for the settlement of conflicts between Capital and Labour.

Information has also been received to the effect that the Ministry of Industry, Commerce and Labour have organized a Department of Commerce for the purpose of collecting and distributing information which will enable produceres in Mexico to send their goods by the shortest and most economical routes to foreign markets.

Firms in Mexico who may be interested are invited to take advantage of the facilities offered to them gratis by the new Depart-

CHEMICAL STANDARDISATION.

The first organised attempt to set up a British Chemical Standardising Body was initiated at a Conference which was held on Wednesday, 4 June, 1930, at the Offices of the Association of British Chemical Manufacturers. The Conference, over which Dr. E. F. Armstrong, the Vice-Chairman of the Association, presided, was attended by representatives of over 50 organisations and industries connected with chemistry, while a further 25 organisations, who were unable to be represented, expressed their sympathy with the objects of the meeting. The Chairman, in a short introductory speech, indicated that the present movement originated with the Standardisation of Tar Products Tests Committee which, at the end of 1929 issued the results of three year's work in a very valuable publication entitled "Standard Methods for Testing Tar and its Products." This Committee found itself faced with the difficulty that the standard methods which it recommended carried no higher authority than its own, and that there was no organisation which was in a position to give a national hall mark to the results of its labours. It therefore submitted to the Association a Memorandum urging that steps should be taken to form a chemical standardising body which would do for chemistry what the British Engineering Standards Association is doing so usefully for engineeriug.

The Association felt that in view of the positive set forth in the Memorandum, the time was ripe for an active endeavour to constitute an organisation capable of meeting effectively all the requirements in regard to chemical standardisation. It therefore decided to circulate the Memorandum to all bodies who were likely to have a direct interest in the subject, and to invite them to a Conference, so that the collective feeling of these bodies might be ascertained. As to the value of carefully conceived standardisation, whether of methods of sampling or analysis, or of specifications or productions, there can be no doubt, since the very fact that several organisations are at present engaged in such work is in itself conclusive proof that standardisation plays a very important part in securing industrial efficiency and economy; it is in fact an essential part of the rationalisation of an industry, and is being adopted by every progressive country.

The need at the moment is for some organisation which will co-ordinate the various standardising activities and when these have been completed give them a national hall mark or recognition. Such an

organisation, by encouraging co-ordinating and facilitating the work of standardisation when such has been proved to be necessary, will expedite the successful accomplishment of the aims of many sections of industry. It is only necessary to point to the British Engineering Standards Association, which has done such valuable work for engineering, to show the type of idea required for chemical standardisation.

At a very early stage in the Conference it was clear that there was unanimity of opinion regarding the need for a chemical standardising body, so attention was then directed to the practical point of determining the type of organisation most likely to fulfil the desired objects. Members of the British Engineering Standards Association, which was represented in forte, described the latest organisation of that Association, in which there are 12 sections representing different industries, each section enjoying an entire autonomy under a Central Council within the terms of the Charter, and urged that chemical standardisation should form part of this organisation. In order to remove any difficulties that might arise from the present title of the Association, steps have been taken to change its name to the British Standards Association, so that it may be in a position to include all forms of standardisation.

After various representatives had expressed their views on the general principles involved, the Conference unanimously passed the following Resolution :—

> "That this Conference of representatives of organisations connected with chemistry and of industries utilising chemistry, is strongly of the opinion that a British chemical standardising body should be constituted; that in the interests of efficiency and economy, there should be a single organisation embracing all forms of standardisation, and that an *ad hoc* Committee be formed to explore the situation as regards chemical standardisation in collaboration with the British Engineering Standards Association, and to report to this Conference."

The constitution of a small but representative Committee of he chemical interests to prepare a detailed scheme was left in the hands of the Chairman. From such an auspicious initiation there was every hope that an organisation will be constituted which will be of immeasurable service to those industries which require chemical standardisation.

FARADAY CENTENARY CELEBRATIONS, 1931.

A Report on the progress of the arrang ments to celebrate in 1931 the Centenary Faraday's discovery of Electro-Magne Induction.

Date of the Centenary.

In 1831 Michael Faraday, following the work of Volta, Oersted and Ampe began, or rather resumed, in his Labo tory at the Royal Institution, experime on the induction of electric currents, and August 29, 1831, made the discovery which lies the origin of the dynamo a starting point of the utilisation of elect power for the purposes of man. On th day, as his Diary shows, he wound two co of wire on to opposite sides of a soft ir ring, connected one coil to a battery a the other to a galvanometer, and at "mak and "break" of the battery circuit observ deflections of the galvanometer connect in the other circuit. From this simple e periment, and the variations of it made Faraday in succeeding trials, have grow in the past hundred years, the science electrical engineering and the great electri industry in all its phases as we know it day. No other experiment in physi science has been more fruitful for manki August 29, 1931, is, then, the centenary one of the greatest events in the history the world, and the greatest event in t history of electrical engineering.

Organisation of the Celebrations.

It is fitting that the lead should be tak in the arrangement of the Celebrations, the Royal Institution, for it was to t House of the Institution in Albema Street that Faraday came in 1813, a you of twenty-two, to become assistant to Humphry Davy, who was then the Prof sor of Chemistry : where later he succeed Davy, and where he lived and worked a gave his famous lectures throughout active life. Faraday took up the wo begun by Davy, and established in the I stitution the tradition of scientific resea and exposition of the highest type whi has been followed in it down to the pres day.

It is no less fitting that the Royal Ins tution should have, in the arrangements 1931, the assistance of the Institution Electrical Engineers, the body representi in this country the profession and indus which owe their existence to Farada greatest discovery. The two Instituti have joined forces in making the plans, a

they are indebted to a number of other societies and organisations for their courtesy and co-operation. The Royal Society will participate in the Celebrations; the British Association for the Advancement of Science have arranged the dates for their Centenary Meeting in 1931, in London, in consultation with the Joint Committe for the Faraday Celebrations; the Federal Council for Chemistry will participate in the arrangement of the Faraday Exhibition, for Faraday's chemical researches, his work on the condensation of gases, his isolation of benzene, and his establishment of the laws of electro-chemistry, are hardly less remarkable than his purely electrical discoveries. Government, University and scientific interests have joined in expressing their interest and offering assistance to make the Celebrations worthy of the occasion.

Institutions Co-operating in the Arrangements.

As a first step a Conference was called at the Royal Institution on 5 February, 1929, to which a large number of representative institntions were invited, including the following :—

Royal Society; British Association; Institution of Electrical Engineers; Institution of Civil Engneers; Institution of Mechanical Engineers; Physical Society; Chemical Society; Faraday Society; Royal Society of Arts; British Science Guild; Institute of Physics; Optical Society; Society of Chemical Industry; Institute of Metals; British Engineering Standards Association; Association of Consulting Engineers; Illuminating Engineering Society; Junior Institution of Engineers; British Institute of Radiology; University of Oxford; University of Cambridge; University of London; Ministry of Transport; Department of Scientific and Industrial Research; British Broadcasting Corporation; The Central Electricity Board; Chemistry Research Board; Electricity Commissioners; British Electrical Research Association; British Electrical Development Association; British Electrical and Allied Manufacturers' Association; Federal Council of Pure and Applied Chemistry; International Electrical Congress; Underground Electric Railways.

Most of these were represented at the meeting. On 17 April, 1929, a further Conference was called at the Institution of Electrical Engineers, at which the following were invited to be represented :—

Association of Mining Electrical Engineers; British Broadcasting Corporation; British Electrical Development Association; British Electrical and Allied Industries' Research Association; British Electrical and Allied Manufacturers' Association; British Engineering Standards Association; British Institute of Radiology; Cable Makers' Association; Central Electricity Board; Conference of Chief Officials of London Electric Supply Companies; Electrical Contractors' Association; Electric Lamp Manufacturers' Association; Federal Council for Chemistry, representing the Chemical Industry; Institution of Civil Engineers; Institution of Welding Engineers; Illuminating Engineering Society; Incorporated Municipal Electrical Association; Incorporated Association of Electric Power Companies; International Commission on Illumination, British National Committee; International Electrotechnical Commission, British National Committee; Imperial and International Communications Company; Radio Manufacturers' Association; Railway Companies' Association; Telephone Development Association; Tramways and Light Railways Association; World Power Conference, British National Committee.

These Conferences approved the proposals to organise Celebrations, and authorised the appointment of Committees, one to be called by the Royal Institution and the other by the Institution of Electrical Engineers, to act jointly in the arrangements. Sub-Committees, to deal with Hospitality, and with the Exhibition and Publicity, have since been appointed.

(To be concluded.)

A GREAT GAS COMPANY'S CO-PARTNERSHIP SCHEME.

A record number of employees of the South Metropolitan Gas Company will this week retire on pension under the Co-partnership Insurance Fund scheme. The fund has now 640 pensioners on its lists.

Of the 34 co-partners now retiring, two are sixty-eight years of age, four are sixty-seven, seven are sixty-six, and twenty-one are sixty-five. Ther average length of service is nearly thirty years, and the aggregate service, taking the group as a whole, over one thousand years.

Included in the list are men from all sections :— store repairers, labourers, fitters, complaints men, blacksmiths, stokers, firemen, porters, inspectors, etc.

The figures are regarded as eloquent testimony to the healthy conditions of service in the industry.

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, June 12.

Papers read :—

The Geographical Representation of the Mountains of Tibet. By SIR SIDNEY BURRARD, F.R.S.

Cleavage Tests in Timber. By E. G. COKER, F.R.S., AND G. P. COLEMAN.

Experiments on the Exchange of Energy Between Gas, Solid and Adsorbed Layer in vacuo. By M. C. JOHNSON. Communicated by S. W. J. Smith, F.R.S.

The following papers were read in title only :—

The Effect of Ozone on the Temperature of the Upper Atmosphere. By E. H. GOWAN. Communicated by F. A. Lindemann, F.R.S.

The Crystal Structure of the Normal Paraffins at Temperatures Ranging from that of Liquid Air to the Melting Points. By A. MÜLLER. Communicated by Sir William Bragg, F.R.S.

Remarks *on the Anomalous Scattering of α-Particles from the Quantum Mechanical Point of View.* By H. S. W. MASSEY. Communicated by R. H. Fowler, F.R.S.

The Energy of Crystal Lattices. By H. JONES. Communicated by R. H. Fowler, F.R.S.

The Oxidation of Phosphine. By R. H. DALTON. Communicated by C. N. Hinshelwood, F.R.S.

The Change in the Area and Catalytic Activity of Metallic Surfaces on Passing from the Solid to the Liquid State. By F. P. BOWDEN AND E. A. O'CONNOR. *Communicated by T. M. Lowry, F.R.S.

The Thermal Decomposition of Ethyl Ether on the Surface of Platinum. By E. W. R. STEACIE AND H. N. CAMPBELL. Communicated by A. S. Eve, F.R.S.

Experiments on the Excitation of Light by Low Voltage Positive Rays. By E. T. S. APPLEYARD. Communicated by Sir Ernest Rutherford, P.R.S.

Relative Intensities of Stark Components in Helium. By G. O. LANGSTROTH. Communicated by A. S. Eve, F.R.S.

The Polar Properties of Single Crystals of Ice. By J. M. Adams. Communicated by H. Bateman, F.R.S.

An Electrical Method of Determining Thermal Conductivities of Metal Wires. By W. G. KANNULUIK. Communicated by Sir Ernest Rutherford, P.R.S.

THE PHYSICAL SOCIETY.

Friday, June 13, at the Imperial Coll of Science, Imperial Institute Road, Sou Kensington, S.W.7. The Following pap were read :—

The Induction of Electromotive Forces a Moving Liquid by a Magnetic Field, their Application to the Investigation of Flow of Liquids. By E. J. WILLIAMS.

A magnetic field induces electromot forces in a moving liquid and by investi tion of the e.m.f's produced by a kno magnetic field it is possible to obtain infor ation about the distribution of velocities the liquid. Preliminary experiments on flow through straight tubes show that pot tial differences of the order of 10^{-4} to 1 volts, set up by a magnetic field in a mov liquid consisting of an aqueous solution copper sulphate, can be satisfacto measured.

The Motion of a Liquid in an Enclo Space. By E. J. WILLIAMS.

The increase of resistance of a colu of mercury in a magnetic field, found experiments on this effect, is due to the ternal motion of the liquid produced by action of the Ampère forces between magnetic field and the electric curr traversing the mercury. The hydrodyna significance of the results of such exp ments is considered, and the consistence the results shows that e.m.f.'s as small 10^{-6} to 10^{-7} volts, induced by a magn field in moving mercury, can be accurat measured. This result also indicates practicability of the method of investi ing the flow of liquids proposed in the vious paper.

Some Notes on Wireless Methods of vestigating the Electrical Structure of Upper Atmosphere (II) By PROF. E. APPLETON, F.R.S.

The comparative discussion of the vari direct wireless methods of measuring "equivalent" height of the atmosph ionised region, begun in the first part of paper, is continued so as to include recently described moving-transmit method of Mirick and Hentschel.

The relations between the optical equivalent paths of waves deviated by upper atmosphere and between the rates which these quantities may vary with t are investigated theoretically, and, fr the results of experiments carried out test these relations, deductions are m concerning (*a*) the existence of more t one ionised region in the upper atmosph (*b*) the possible influence of magn storms on atmospheric ionisation, (*c*)

gradient of ionisation in the upper atmosphere and its alteration under solar influence at sunrise, and (*d*) the actual height reached by waves deviated in the upper atmosphere.

A Simple Method of Showing the Modes of Vibration of a Wire. By C. R. DARLING, F.Inst.P., F.I.C., Assistant Professor of Science, Royal Military Academy, Woolwich.

A method is described of showing the modes of vibration of a wire by heating it with alternating electric current and varying its tension, the various modes being easily observable owing to the luminosity of the wire.

This paper was illustrated by a demonstration.

A demonstration was given by Dr. H. R. Lang, of the Imperial College of Science, of a modified Callendar recorder for the automatic control of a high-temperature oil bath.

MINERALOGICAL SOCIETY.

Tuesday, June 3.

The following papers were read :—

A New Meteoric Iron from Piedade do Bagre, Minas Geraes, Brazil. By DR. L. J. SPENCER.

This mass, found in 1922 and weighing 130 lb., is of special interest in showing on one corner a cell-marked octahedral fracture, and on a polished and etched section taken from this portion of the mass a complex system of very distinct Neumann lines. Neumann lines are twin-lamellæ produced by gliding on planes of the icositetrahedron (211); and it is believed that these, as well as the octahedral fracture, were developed by the shock of impact when the meteorite fell with its corner on hard rock.

Notes on British Barytes. By MISS JESSIE M. SWEET.

It is shown that the localities of barytes and fluorite follow the outcrop of the Whin Sill in the North of England and of the toadstones in Derbyshire. Attention is drawn to a change in colour from yellow to blue in some barytes crystals from Mowbray mine, Frizington, Cumberland, on exposure to the light. Zoned crystals, and some rare crystal-forms are described.

On Face- and Zone-Symbols Referred to Hexagonal Axes. By H. H. HEY.

The three hexagonal zone-symbols for any one zone referred to the Bravais axial system and obtained by cross multiplication of face-symbols dropping the first, second, or third index, all obey the Weiss zone-law and when added together applying a factor of $\frac{1}{3}$ for the fourth index yield a four index zone-symbol identical with that obtained for the zone from the gnomonic or linear projection. This four index zone-symbol also obeys the Weiss zone-law if a factor of 3/2 be applied to the unique index when operating upon the face-symbols of a face in the zone. General expressions are obtained for passing from any one of the three index zone-symbols to the other two and also to the four index symbol and *vice-versa.*

Biographical Notices of Mineralogists Recently Deceased (Fourth Series). By DR. L. J. SPENCER.

For the past three years thirty-eight biographies are included. Ages range from 32 to 91 years with an average of 68. Prominent are P. Groth and G. Tschermak, who both died in 1927.

A Tholeiitic Phase of the Quartz-dolerite Magma of Central Scotland. By DR. F. WALKER.

The tholeiites of Dalmeny and Kinkell are described and shown to contain chlorophaeite. It is demonstrated by means of analyses and refractive index determinations that the residual glass is of acid composition in both rocks : a conclusion which does not support some of the ideas of Dr. C. N. Fenner on the crystallisation of basalt.

On Pink Epsomites and Fauserite. By M. H. HEY.

A supposed specimen of the latter in the British Museum proves to be pink epsomite. Fauserite is a doubtful species.

GEOLOGICAL SOCIETY OF LONDON.

May 28, 1930. Prof. E. J. Garwood, M.A., Sc.D., F.R.S., President, in the chair. The following communication was read :—

The Post-Glacial Deposits of the Lincolnshire Coast. By PROF. HENRY HURD SWINNERTON, D.Sc., F.G.S.

The clays which underlie the Lincolnshire marshland crop out between the tide-lines along the coast, and many temporary exposures have been examined in the vicinity of Chapel St. Leonards and Ingoldmells. These deposits lie upon an uneven floor of boulder-clay, and may be divided into Lower, Middle, and Upper Series, separated by well-defined erosion surfaces.

The Lower Series consists of peat enclosing remains of oak, alder, and birch. It was formed during Neolithic times, when the area must have been at least 20 feet above its present level.

The Middle Series consists almost entirely of purple and grey buttery clays, and rests upon an eroded surface of boulder-clay and peat. It is usually 7 feet thick, and is divisible into lower and upper portions by a marked difference in the contained flora: the former, which makes up the greater part of the series, contains a salt-marsh flora including abundant remains of *Posidonia*, a form now confined to warmer latitudes; the latter contains a freshwater marsh flora. The upper boundary of this series is defined by a thin peat upon which, in the neighbourhood of Ingoldmells, rest heaps of debris derived from late Bronze Age (and possibly early Iron Age) salt-workings.

The Upper Series consists of grey, purple, and black sloppy clays, with numerous *Scrobicularia* and *Cardium* in their lowest portions. They rest upon a deeply eroded surface made up of all divisions of the underlying deposits. The thickness varies from 18 to 9 feet. There is evidence that this series was formed after the Roman occupation.

The character and contents of these post-Glacial deposits indicate deposition under estuarine conditions, associated with the presence of an off-shore barrier. It is suggested that this barrier was breached during the 13th and 14th centuries, and thus the present exposed condition of the coast was established.

An interesting discussion followed.

REPORT OF THE BENZOLE RESEARCH COMMITTEE, 1930.

The Seventh Annual Report of the Joint Research Committee of the National Benzol Association has just been issued.

The work that has been carried out by this Committee and the Report which has been compiled represents co-operative effort for the purpose of research between representatives of a large and important British Industry and those of a prominent University. Their past reports, and the report enclosed is some indication of the success of their effort.

The nature of the work carried out, and the subject matter, is of special interest at the present time, for it represents an attempt at the application of systematic research to increase the supplies of Benzole Motor Spirit produced in this country from coal.

COAL OUTPUT IN GREAT BRITAIN

For the week ending May 17 the number of miners employed was 536,000 and the coal mined numbered 4,855,700 tons, the figures for May 24 were 534,000 miners and 4,827,000 tons.

SUEZ CANAL TRAFFIC IN 1929.

We give particulars of the traffic passing through the Suez Canal during 1929. Transit receipts for the year totalled 1,122,891,86[illegible] francs, while the vessels passed through numbered 6,274.

CENTENARY OF H. H. HICKMAN.

The works of Henry Hill Hickman (1800-1830), a pioneer in anæsthesia, have been saved from oblivion by Dr. H. S. Wellcome, the Director of the Wellcome Historical Medical Museum at 54, Wigmore Street, London, W, Dr. D. Wilmot Buxton B.S., M.R.C.P., and Dr. J. D. Comrie M.A., M.D.

In preparing the Museum, Dr. Wellcome sought out the evidences of agents employed through the ages to lull and numb the senses and to alleviate pain and suffering. Investigations into the history of anæsthetics revealed, *inter alia*, unrecorded documents relating to Hickman's rôle in the development of this subject. The material was incorporated in the exhibits of the Wellcome Historical Medical Museum but had not been published until the centenary of Hickman's death, when the Wellcome Foundation printed a *Souvenir* of the Centenary Exhibition (pp. 85). In this interesting contribution to the literature of the history of science a number of letters and manuscripts have been reproduced together with numerous illustrations.

As Dr. Wilmot Buxton says, it is extremely difficult to appraise justly the work of Hickman. His work was compressed into five years and was carried out whilst he was practising as a village doctor. Just prior to his time great strides had been made in chemistry as a result of the researches of Lavoisier, Priestley and others and these were followed by the even more far-reaching work of Davy and Faraday. In 1800, Sir Humphry Davy suggested that nitrous oxide might be used with advantage for destroying physical pain during surgical operations. No further attention was paid to this suggestion, however, until in 1824 Hickman carried out experiments on animals by operating after administering carbon dioxide. He recognised that the

apours introduced into the lungs and ɪence into the blood stream should ensure leep for the patient whilst undergoing an peration. His experiments with animals nder carbon dioxide was ahead of his ime and he lacked the confirmation of his xperiments by prominent professional colɜagues. He sought the help of a friend, . Mr. T. A. Knight, F.R.S., whom he asked o lay his work before Davy and the Royal ociety. Hickman simultaneously published pamphlet (quoted in full in the *Souvenir*, p. 31-35) entitled, *A Letter on Suspended Animation, containing Experiments showng that it may be safely employed during Operations on Animals, with the View of Ascertaining its Probable Utility in Surgical Operations on the Human Subject, addressed to T. A. Knight, Esq., of Downon Castle, Herefordshire, one of the Presidents of the Royal Society.**

Like many other pioneers, both before and after his time, Hickman met with no encouragement. Lack of recognition at home prompted him to go to Paris in 1828 and present a memorial to Charles X of France. The memorial was forwarded to the Académie Royale de Medécine and was considered on September 28, 1828, but no further help or co-operation was forthcoming from Paris surgeons. Finding that his researches were ignored by the French as well as the English medical profession, Hickman returned home a disappointed man and died shortly afterwards.

Attention was later directed to his work by Dr. Thomas Dudley, when a controversy arose in 1847 between Morton, Wells and Jackson, concerning who among them was the inventor of the system of inhaling ether for the purpose of causing insensibility during surgical operations. Dr. Dudley, with the help of Hickman's widow, was able to show in the contemporary medical press that all had been anticipated by Henry Hill Hickman, although no attention had been paid to his experiments at the time.

Tardy recognition has now been paid to Hickman—thanks to the Wellcome Foundation—and a tablet has been placed on his grave at Bromfield by the Section of Anæsthetics of the Royal Society of Medicine.

---

* Knight was a Fellow, but never President of the Royal Society.

Forthcoming Events

THE ROYAL SOCIETY.

Thursday, June 26, at 4.30 p.m.—The following papers will be read :—

"The Vapour Pressure of Muscle." By A. V. Hill, F.R.S., and P. S. Kupalov.

"The State of Water in Muscle and Blood and the Osmotic Behaviour of Muscle." By A. V. Hill, F.R.S.

"The Gyromagnetic Effect for Paramagnetic Substances. By W. Sucksmith. Communicated by A. P. Chattock, F.R.S.

THE INSTITUTION OF MINING ENGINEERS.

The Ninety-first General Meeting of The Institution of Mining Engineers will be held at Birmingham on July 9-11. The Council of the South Staffordshire and Warwickshire Institute of Mining Engineers have arranged an interesting and instructive programme

New Patents

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

16,356.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of complex salts of organic compounds. May 27.

16,769.—I. G. Farbenindustrie Akt.-Ger. —Manufacture of carboxylic acids from nitriles. May 30.

16,901.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of iodomethane sulphonic acid &c. May 31.

16,639.—I. G. Farbenindustrie Akt.—Ges. —Manufacture of quinoline and acridine compounds. May 29.

Specifications Published.

306,843.—I. G. Farbenindustrie Akt.-Ges. Process for the manufacture of azodyestuffs containing chromium.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

Abstract Published.

327,830.—Amines. Imperial Chemical Industries, Ltd., Millbank, London, and Kenner, J., College of Technology, Sackville Street, Manchester.

m-2-Xylidine is separated from the residual oil after the removal of 1 : 3-dimethyl-1-4-aminobenzene, and 1 :4-dimethyl-2-aminobenzene from the mixture of isomeric xylidenes obtained from commercial xylene, by converting it into the nitrate. After treating the crude oil with sulphuic acid to *remove the greater portion of the other isomers, the filtrate is either basified and* treated with nitric acid, or directly treated with a soluble nitrate, the separated nitrate being then purified by crystallization from water and basified. In examples (1) the crude oil is treated with sulphuric acid, filtered, rendered alkaline, and nitric acid is added, the precipitate being then recrystallized; (2) the liquor remaining after sulphuric acid treatment, and filtering, is treated with solid sodium nitrate, and the precipitate purified.

The Latest TRADE MARKS

This list of Trade Marks of interest to Readers has been selected from the Official Trade Marks Journal, and is Published by permission of the Controller of His Majesty's Stationery Office.

DUROBELLE.

512,324.—Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. —Arthur Sanderson & Sons, Ltd., 16a, Newman Street, London, W.1. June 4th.

ALUNDUM.

509,438.—Crystalline alumina, being a Chemical substance for use in the manufacture of bonded granular materials particularly for abrasive or refractory purposes.—Norton Co., New Boid Street, Worcester, Commonwealth of Massachusetts, United States of America. June 4th. (Associated).

Messrs. Avery, balance and weigh manufacturers, of Birmingham, are cel brating their bi-centenary. Though the fir is celebrating its great age it is identifi with the most modern development Balances of the finest and most delica accuracy for pharmaceutical and scientif purposes are one of its specialities, and a the most modern types for laboratory u are included in its output.

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OTICE TO AUTHORS & CORRESPONDENTS.

Contributions for publication either as riginal articles or in the correspondence olumns are welcomed by the Editor of *'he Chemical News.*

They must be accompanied by the conibutors' full names and addresses, not ecessarily for publication, but as an idication of good faith. If a reply is eeded or if it is desired that a manuscript 'hich is not accepted for publication be eturned, a stamped addressed envelope hould be enclosed.

No notice can be taken of anonymous tters.

AMIDATION OF NITRO-*p*-DICHLOROBENZENE.

By L. McMaster and A. Steiner.
(Washington University, St. Louis, U.S.A.)

Para-chloro-*o*-nitroaniline, an important dye intermediate, has generally been prepared by heating nitro-*p*-dichlorobenzene, dissolved in sufficient alcohol, with ammonia under pressure at varying temperatures and for different periods of time. It is described as orange-red needles of melting points from 115° to 116.5° C.

The object of this investigation was to prepare the *p*-chloro-*o*-nitroaniline from nitro-*p*-dichlorobenzene, using aqueous ammonia, with and without catalysts, in an autoclave so as to arrive at the optimum conditions of time, temperature, pressure, and ammonia concentration.

Experimental Procedure.

The apparatus used was a brass-lined autoclave of 2 litres capacity, provided with an iron stirrer and thermometer well. The nitro-*p*-dichlorobenzene was supplied by the Monsanto Chemical Works. It had a melting point of 54.5° C.

In each experiment 25 grams of the nitro-*p*-dichlorobenzene were heated with 140 grams of 28 per cent. ammonium hydroxide. This corresponds to 18 mols of ammonia for each mol of the nitrodichlorobenzene. After each run the autoclave was allowed to cool. The contents consisted of an orange liquid portion and a solid portion. The liquid contained unused ammonia, ammonium chloride, and a small amount of the *p*-chloro-*o*-nitroanaline.

The solid portion was a dark red crystalline mass, consisting of a small amount of carbon, some unchanged nitro-dichlorobenzene, and the *p*-chloro-nitroaniline. This mass was crushed and successively treated with small portions of hot hydrochloric acid (sp. gr. 1.18) and filtered at once. About 500 cc. of acid were required. This acid extract was cooled and poured into water. The *p*-chloro-*o*-nitroaniline, of melting point 115° C., separated in the form of orange crystals, which were filtered off, dried at room temperature, and weighed. When recrystallised from boiling water, in which it is slightly soluble (1 gram in about 300 cc. of water), it consisted of orange needles of melting point 115.8-116° C.

The diluted hydrochloric acid was used instead of water for further precipitations.

Extraction with 36 per cent. acetic acid does not give such good results on account of considerable difficulty in removing the

last traces of the acid. Numerous other solvents, such as ether, alcohol, acetone, petroleum ether, were tried, but none were so satisfactory as the hydrochloric acid.

Steam distillation of the solid portion was tried as a means of removing the unchanged nitrodichlorobenzene from the *p*-chloro-*o*-nitroaniline. In one experiment 40 grams of the dark red crystalline mass were steam-distilled for 1 hour. After 1 litre of liquid was distilled off there separated out 2.5 grams of a yellow, non-crystalline mixture of unchanged nitrodichlorobenzene and *p*-chloro-*o*-nitroaniline. The distilling flask contained a dark red residue and a red solution. From the solution 3 grams of pure orange-red crystals of the amine separated. The residue in the flask weighed 34 grams (85 per cent. yield), melted at 110-111° C., contained some carbon, and was impure *p*-chloro-*o*-nitroaniline. Purification by steam distillation was thus found to be impracticable.

A rapid method for checking the per cent. yield of the amine was devised. After drying and weighing the material as described, it was dissolved in anhydrous ether, and dry hydrogen chloride was run into the solution. The light grey hydrochloride of the amine immediately precipitated in a quantitative yield. The ether was poured off and the hydrochloride allowed to stand in the air. Hydrochloric acid rapidly split off and left the free amine.

TABLE I.

YIELDS OF *p*-CHLORO-*o*-NITROANILINE.

	Hours	Pressure Cm.Hg	Temperature °C.	Yield Per cent.
1	2	852	120	Trace
2	2	1100	135	61
3	2	1369	150	80
4	2	1369	150	82
5	2	1369	150	81
6	4	1369	150	92
7	4	1369	150	90
8	5	1369	150	92
9	2	1627	170	92
10	2	1627	170	93
11	2	1627	170	91
12	4	1627	170	85
13	2	1627	160	85
14	5	1627	170	83
15	2	1885	185	80

A series of experiments was also made using catalysts vanadium pentoxide and copper salts. It was thought that these catalysts might induce the formation of the diamine. In no instance was *o*-nitro-*p*-phenylenediamine formed. In fact, the results of eight such runs showed smaller yields of the *p*-chloro-*o*-nitroaniline than when no catalyst was used. The iron stirrer of the autoclave probably affected the efficiency of the copper salts. An increase in time of heating caused an increase in the amount of carbon.

Results.

Table I gives the yields of pure *p*-chloro-*o*-nitroaniline. The temperatures were kept within 5 degrees of the recorded figure throughout the runs. In each case the ammonia concentration was 18 mols per mol of the nitro-*p*-dichlorobenzene except in run 13, where 28 mols were used. In runs 12, 13, 14 and 15 the amount of carbonisation increased as the running times and temperatures increased. The corresponding decrease in yields is quite uoticeable.

Conclusions.

The best conditions for the production of *p*-chloro-*o*-nitroaniline from nitro-*p*-dichlorobenzene by amidation were found to be heating for 2 hours, with constant stirring, 170° C., 1627 cm. mercury pressure, with 18 mols of ammonia per mol of the nitro-*p*-dichlorobenzene without catalysts such as vanadium pentoxide and copper salts.

The maximum yield of the product was 93 per cent. of orange-red needles of melting point 115-116° C.

(Abstracted from *Industrial and Engineering Chemistry*, May, 1930.)

THE STEAM AND POWER PLANT AT BILLINGHAM.

ESSENTIAL DETAILS OF A REMARKABLE INSTALLATION.

By A WELL-KNOWN ENGINEER.

An elaborate paper read recently before the Institution of Electrical Engineers (London) by H. A. Humphrey, D. M. Buist, and J. W. Bansall, dealing with the new steam and power plant of Synthetic Ammonia and Nitrates Ltd. (Imperial Chemical Industries Ltd.) at Billingham-on-Tees, gives for the first time a comprehensive description equally as striking as the River Rouge plant at the Ford Works, Detroit. It is difficult to summarise the paper, which is written in condensed fashion and packed with drawings, diagrams and figures, but of the main features of the installation, as now completed, are a boiler plant operating at a maximum pressure of 800 lbs. per square inch and 856°F. super-

ated steam temperature, fired with pul-
rised fuel on the latest principles, a huge stilling plant of about 2500 metric tons 204 lbs.) of distilled water per 24 hours pacity for the make-up water, 7-stage d-water heating, high pressure turbines special design, an elaborate system of tomatic control of steam generation and quency and unusual lay-out features for complicated network of pipes and bles.

The boiler plant has been designed and nstructed by International Combustion d., and consists of eight very large forged um boilers of the semi-vertical four-drum pe, each with minimum operation of 5,000 lbs. of water per hour and 700 lbs essure and 269,000 lbs. and 800 lbs maxi- um, along with gill-tube steaming, econo- sers, air heaters, sueprheaters, and dust tractors. The normal duty is the enorm- s figure of 11,700 metric tons of water aporated per 24 hours, constituting one the largest steam plants in the United ngdom, and the operation is by means of Lopulco" pulverised fuel firing.

The equipment includes ten "Raymond" ler mills each of 15 tons of coal per 24 urs capacity, while the air is preheated 500° F. and the comubstion chamber lls are built up of "Murray-Usco" fin be walls. Also each boiler is fired by r "R" type turbulent burners, totalling ile the forge steel drums (32 in all) are tons of coal per boiler per hour capacity, t. 0ins. long, 4ft. 6ins. internal diameter, d 4½ ins thick weighing 56 tons, made m 151 Steel ingots.

The whole of the steam passes to five tur- nes of 12,500 K.W. each, normally 630 . pressure and 833° F. at the stop valve, which three are of the back-pressure, gle-cylinder 16-stage type with cylinder d two steam chests of forged steel, while other two are condensing units, partly nd-by. As a rule about 60 per cent of total steam generated, that is 6930 tons r 24 hours out of 11,700 tons is required process work, with 3994 tons returned condensed water, while electricity up to 500 K.W. is also produced. These back- essure turbines exhaust at 290 lbs. and out 650° F. to the ordinary process mains ich connect also to separate boiler plant, d the whole installation is also one of the st impressive examples in the world of importance of the back-pressure princi- for many industries, at least 70 in [illegible]

BRITISH EMPIRE TRADE EXHIBITION, BUENOS AIRES.

March 14 to April 27, 1931.

As a result of the initiative of the British Chamber of Commerce in Buenos Aires, a British Empire Trade Exhibition is to be held in Buenos Aires from the 14 March to the 27 April, 1931. This Exhibition—the first of its kind to be held in South America, or indeed in any foreign country— is a project of the first importance from the point of view of British trade with the Argentine Republic. It is being officially supported by His Majesty's Government, and the Department of Overseas Trade are organising an exhibit in a building which has been provided by the Exhibition management. Other steps will be taken, in addition, to render the occasion impressive and to bring the prestige of Great Britain prominently to the notice of the Argentine people. The British banks, railways, shipping and cable companies, and other British commercial undertakings in the Argentine are giving their warm approval and financial support, and the Argentine Rural Society have placed their grounds adjoining Palermo Park, in the centre of Buenos Aires, and the buildings which they contain, at the disposal of the organisers. In addition, temporary buildings are being erected as the needs of the enterprise dictate.

The Canadian Government are also organising a series of exhibits.

The Exhibition will be organised in a series of indnstrial sections which will include, among other things, applied science and chemicals.

A large amount of the available space has already been taken by British firms and commercial organisations, who realise the value of the opportunity afforded by the Exhibition as a means of stimulating their trade with Argentina.

The address of the London Committee of the Exhibition is: The General Manager, British Empire Trade Exhibition, Buenos Aires 1931, 5 Parliament Mansions, Orchard Street, Victoria Street, London, S.W.1. ('Phone Victoria 0877), from whom full information can be obtained.

BRITISH SUBJECTS NOT OBLIGED TO GIVE SECURITY FOR COSTS IN FRANCE.

The British Commercial Counsellor at Paris has forwarded an extract from the *Gazette du Palais* giving the text of a judgment of the Tribunal of Commerce of the Seine of March 4 last, whereby the Court decided that British subjects are not obliged to give security for costs.

THE CHEMICAL COMPOSITION OF COLLOIDAL MATERIAL ISOLATED FROM THE HORIZONS OF VARIOUS SOIL PROFILES.

By I. A. Denison.

Assistant Chemist, Soil Investigations, Bureau of Chemistry and Soils, United States Department of Agriculture.

Investigation of the chemical composition of colloidal material isolated from the soil has been confined largely to that occurring in the upper part of the soil profile; that is, in the A and B horizons. This work has indicated the extent to which soil colloidal material may vary in composition over a large area, namely, the humid portion of the United States, as well as in restricted areas of the same or related soils. It is important, however, especially in connection with the study of soil genesis and profile development that something be known of the composition of colloidal material in the lower part of the profile, in the C horizon, and in the zone of decomposing rock. Although colloids of the A and B horizons of most soils are of similar composition, it is not unlikely that greater differences might be found in colloids in the deeper parts of the profile where nature of the parent material rather than climatic influences would be expected to determine the composition of the colloid material. Comparison of the composition of colloidal material isolated from the upper soil horizons with that occurring in the lowest horizons should indicate what changes have taken place in the colloid as the result of leaching and ageing.

The most extensive investigation of the composition of colloidal material isolated from the soil is that reported by Robinson and Holmes. The investigations of others on the finest fractions of the soil have been reviewed by these writers and need not be considered here. Robinson and Holmes concluded from their study of the colloidal material in the A and B horizons of 15 American soils that the colloids isolated from the surface soil and from the corresponding subsoil are much alike in composition. More recently Holmes reached the same conclusion from his study of colloids from the Leonardtown soil. McCool has reported partial analyses of colloids from a group of Michigan soils which indicate rather wide variations in certain constituents in the different horizons. Potash appears to increase regularly with depth in the profile. Silica decreases regularly in most of the profiles studied, but in several it increases regularly with depth. Phosphoric acid, lime, magnesia, and soda als show considerable variations which do no appear to follow any definite order.

Methods.

Colloidal material was isolated from th soil essentially as described by Robinso and Holmes and in other publications c this bureau. A diameter of 1 micron wa taken as the upper limit of colloidal parti cles. The colloidal material was isolate quantitatively, and an effort was made t remove all the colloid present that could b dispersed by the method employed. Th details of the process are as follows: A 20 0to 400 gm. sample of soil material, de pending on the quantity of colloid present was worked by hand to a plastic conditio and dispersed in about 50 litres of distille water. The water was made alkaline t phenolpthalein by ammonia. The suspen sion was passed through a high-power cen trifuge and the colloidal material was con centrated by drawing off the water throug Pasteur-Chamberland filter candles. Th residue in the centrifuge was dispersed i water as before and centrifuged, the proces being repeated until a dispersion of th material in 3 litres of water gave after cen trifuging only a slightly opalescent solution In most cases this final colloidal solutio contained 0.1 gm. or less of solid material In other cases it seemed impossible to reac quite this lower limit. The concentrate colloid was evaporated to dryness on th steam bath.

The isolated colloids and their correspond ing soils were analysed by the fusion metho as given by Hillebrand. Combined wate was estimated by deducting from the loss o ignition the organic matter, which was de termined as CO_2 by the dry-combustio method, the factor 0.471 being used. Value for organic matter so obtained are, c course, only approximate and in individua cases may vary widely from the true values Determinations of pH values were mad electrometrically.

The samples used in this investigatio were selected to represent a wide range o soils which have developed under humi conditions. The profiles varied in thei characteristics from the Emmet, a typica podsol, to the Barnes identified as Cherno zem. The other profiles selected possesse characteristics intermediate between thes extremes. They were mainly from th southern part of the piedmont plateau. Thi region was represented by three soil series the Cecil, the Porters, and the Durham, th profiles differing chiefly in degree of matu ity. The Cecil profile is fully developed

Porters somewhat less mature, while
Durham profile is immature. These
ee profiles have developed from gneiss.
A second Cecil profile derived from mica
ist was included in this group to bring
possible differences in the composition
colloidal material that may have been
iuced by a different kind of parent mater-
. A profile of the Houston series, a
ndzina, was also chosen for examination.

As will be seen from the foregoing, this
estigation deals with the composition of
loidal material in the horizons of the soil
ofile. Colloidal material was isolated
antitatively from seven soil profiles re-
esenting a wide range of composition and
ofile characteristics. It was found that in
ne profiles the colloidal materials were
rly constant in composition; in other
ofiles the colloids varied rather widely.
e constituents in which variations were
st general were silica, alumina, iron,
ganic matter, and combined water. Ex-
pt in the case of profiles developed from
icial material the percentages of the bases
owed little variation with depth and were
v in all horizons. Silica and alumina
ried regularly in all profiles in which the
loids were not practically constant in
nposition. These variations, however,
re not always in the same direction.

The molecular ratio of silica to alumina
is iron showed in the case of colloids
m several profiles a regular decrease with
pth, indicating that extent of weathering
s not the chief factor tending to reduce
s ratio. The relatively low silica-sesqui-
ide ratios were attributed to the presence
free hydrated alumina in the colloidal
iterial of the lower horizons. Further
idence of the presence of free alumina was
tained by fractionating the colloid show-
g a low silica-sesquioxide ratio. The col-
dal fractions were found to contain a
gher proportion of alumina to silica and
ore combined water than the gross col-
dal materials. The presence of free
imina in the colloid of the lower horizons
is accounted for on the assumption that
lloidal material existing on the surfaces
altering mineral particles contains free
imina.

The relatively high percentages of alum-
a and combined water in disintegrated but
parently undecomposed parent rock and
e low pH values of this material indicate
at some of the minerals composing this
aterial have undergone extensive altera-
n.—*Journal of Agricultural Research,*
ashington.

TECHNICAL PREPARATION OF ANHYDROUS ALUMINIUM TRICHLORIDE.

By Dr. C. Wurster.

(*Abstract of a paper read at the General Meeting of the German Chemical Society, Frankfort on Main, June* 11.)

Anhydrous aluminium chloride has been known for over a hundred years. The oldest method of preparation is that of Oersteut in which alumina, carbon and chlorine react together with difficulty on heating. This method was recently partly replaced by the synthesis of aluminium trichloride from the metal and hydrochloric acid.

From our researches at the I. G. Farbenindustrie works at Ludwigshafen on Rhine, the late Dr. J. Brodie and the author have found that it is possible to carry out a continuous preparation of anhydrous aluminium trichloride on the large scale by the interaction of raw material containing alumina, e.g., clay or bauxite, with chlorine and carbon monoxide and that the heat of the reaction does away with the necessity for the application of external heating. The operation is carried out in a Schacht oven 30-60 feet high on the counter-current principle. A yield of several tons daily is easily possible and the process can be continued for years without interruption.

The product was found, on analysis to contain about 97 per cent. of aluminium chloride whilst the chief impurities were ferric chloride (about 2.5 per cent.) and titanium chloride (about .5 per cent.). The product can be used for most purposes in place of the more expensive pure compound. So far its chief applications have been in the preparation of dyestuffs and of perfumes and in the petroleum industry.

ELECTRICITY IN SWEDISH INDUSTRY.

The Commercial Counsellor, H.M. Legation, Stockholm, has forwarded a summary translation of an article dealing with the progress of the use of electric power in Sweden which has recently been published in the official organ of the Kommerskollegium (Board of Trade).

Statistics of electric power used in Swedish mining and industry were collected for the first time in 1906, and the figures given show the remarkable increase in the use of electric power which has since taken place.

A copy of the translation may be obtained on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

THE CHEMICAL ATOM AS DISCONTINUOUS MATTER. H, He, Li, C. PART II. CRITICISM — ATOMIC WEIGHT AND ATOMIC NUMBER.

By Dr. W. Tombrock.

The criticism, which I have received with regard to the previous publication was of two kinds: both destructive and appreciative.

The first pretended not to understand it and furthermore stipulated the absence of arguments, the latter pointed to Descartes who in an explanation of the solar system arrived at something which much resembled our explanation of the mechanism of the atom.

We will briefly elucidate and reply to this criticism.

As regards understanding it: the proton is an ether-whirl comparable with a very much intensified tornado in our atmosphere. This tornado causes a secondary ether-current or wind around its primary centre of motion. This secondary ether motion takes the form of a closed orbit. Its core falls in a plane perpendicular to the axis of the *primary protonic motion. This secondary* ether motion can be seen easily enough from the sketch (see fig. 1 of the previous publication) in which the primary motion is represented as a spiral, which reminds one more or less of that of a spring mattress. It gives a logical answer to the question as to why an electron, being a material particle of larger volume, describes a closed orbit in an atom and moreover has a "spin." The appreciative criticism here will presently further come to your assistance in this and set you at rest.

Now as concerns van 't Hoff's carbon tetrahedron it is remarked that you can obtain a clear idea of this by drawing the axes of primary protonic motion between the centres of the six edges (fig. 6). The common intervals of the secondary orbits of motion then coincide for the fonr protonic triads along two systems of axes, one of which connects the centres of the sides with the centre of the tetrahedron and the other the corners.. The ether then flows, so to speak, inwards at the centres of the sides of the tetrahedron and out again at the corners—or *vice versa*, as you will.

But now the arguments *for this stereochemical* construction of the atom from its prontons, arguments which our first critic did *not* see . . . these are very simple:

1st. *The chemical atom is stable*, thus the protons *must* be connected with each other, we said, are "coupled." The old-fashioned standpoint that the protons would together form an atomic nucleus is

repel one another as positive units of ele tricity. As an "explanation"—witho giving more particulars about it—this rè resentation is simply pertinent nonsense.

The stability of the atom logical demands a connection between the proto in it and *we* gave that connection in cor mon intervals of the secondary orbits motion. In our opinion this is an argume of the first order.

2nd. *Directional properties* must play part in atomic construction, as a result which the atom as a structural unit in o ganic stereochemistry becomes understan able . . . in *our* idea this directing eleme clearly makes its appearance.

3rd. *A connection between atom weight* (number of protons) *and atom number* is asked for by a logical constru tion of the atom from its protons. O mode of thought enables the atomic nur bers to be read off directly from the di grams representing the protons. Tl atomic number is namely the number planes in which the orbits of secondary m tion fall. Through the coincidence of son *of these planes we count the following nur* bers for the elements mentioned; H : He : 2, Li : 3 and C : 6.

4th. We saw with the hydrogen molecu an electron would change its path throug a very *small impulse, from one route* secondary motion into two, whereby th new orbit thus becomes very nearly twi as long. With lithium an alteration fro one or two into three lengths evidently b comes possible, etc.

5th. On a closer examination speci entrances and exits to the atom becom visible through the ether flow as a result o our protonic coupling.

6th. The portion being a tornado in th ethereal atmosphere ether particles will cor tinually come in while others retire from th protonic whirl-dance. By this means a per manent renewal can be effected and it is t be understood how gravitation is workin continually . . . as it has already bee pointed out: the manifestations of gravita tion and similar phenomena are to be attrib uted to the action of *protons*, whereby i the cyclonic motion the particles in gener *lose translational* motion and *gain rota tional* motion. Through this is produce a *relatively* increasing pressure of the sur rounding particles by which protons an proton-complexes are driven in the direc tion of the *least resistance*. We must stipu late here a difference between *primary* (gravitation) and *secondary* protonic phe nomena, the latter correspondng to th stereochemical arrangement of protons (an

Those are thus six arguments for our idea : *Stability of the atom, directional properties in stereochemistry, connection between atomic weight and atomic number, simple quantitative alteration of the length of the orbit when, through a very small impulse, the electron takes on another path, special inlet-and outlet ports for electrons, the obviously clear explanation of gravitational and similar effects through the cyclonic movement and continuous renewal of the prontons and* . . . now further the second critic. The latter compares our atomic theory to the vortex theory of Descartes and then writes :

" His vortices and your picture of the atom might almost be said to be a minature edition of his idea of the solar system, particularly with regard to the way the electrons are dragged along by the protonic whirls,"

I did *not* know this theory of Descartes. But our starting point must here be the same : *discontinuity of matter*, and in so doing our picture of the atom logically resembles his cosmic conception. This, for the rest unexpected, agreement also speaks in favour of an attempt to arrive at an understandable *stereochemical construction of the atom from its protons.*

Conclusion.

About five years ago I undertook, by considering, discussing and thinking about the generally known modern empirical scientific data concerning material properties, to arrive at a clearly drawn representation of the ultimate structure of matter.

I may thank here the correspondents who in the course of these years have assisted me in my endeavour by their criticism. Most of all the English physicist who translated my work from the Dutch into English and who, moreover, gave useful hints here and there about the literature of the subject. Much also the Editor of " *The Chemical News* " for granting—for so long—hospitality in his journal to my contributions.

One objection has been raised against my work, it being the absence of the mathematical treatment which is so characteristic in physics nowadays. But to my defence may be that in this close logic must lead the way, logic going fairly well without mathematics here. Moreover chemisty, particularly organic chemistry, has obtained its end without mathematics in the finer sense of the word and is now considered by many scientists as the most exact branch of human knowledge.

As for the result obtained it may be remarked that the obvious contrast between proton and electron with regard to the fundamental properties of volume and mass effect (weight) forces us to consider the electron to be a particle of larger volume, the pronton, however, to be of a more complex structure. Thus I understood the proton as a cyclonic whirl or tornado in an ether of very fine simple particles with considerable velocities, indeed the greatest velocities existing, and moving as the molecules of a *gas* move. The *chemical atom* finally constructed from these fundamental units, protons and electrons, but first of all from *protons*, I depicted in my previous publication.

May, 1930,
Bergen op Zoom (Holland).

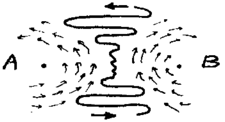

fig. 1 - proton

fig. 2 - proton

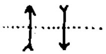
fig 3 . H_2

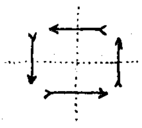
fig. 4 - He

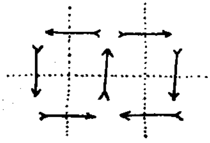
fig. 5 - Li

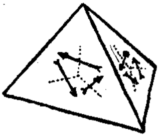
fig. 6 - C. van 't Hoff

GENERAL NOTES

CANADA'S LEADING MINERAL PRODUCTS IN MARCH.

Monthly production statistics relating to Canada's leading minerals are available since January, 1929, when the collection of these data was undertaken by the Dominion Bureau of Statistics. This report is the third issue of the monthly series.

Features of the month under review were the monthly records set up in the output of copper, lead, petroleum and zinc.

Canada's copper production of 28,194,655 pounds showed an advance of 50 per cent over the total for March 1929. Ontario was the chief producing province with an output amounting to 12.28 million pounds; Quebec produced 8.63 million pounds; and British Columbia followed with a production of 7.28 million pounds. A review of the first quarter of 1930 shows an increase in copper production of 35.4 per cent over the same period of 1929. Copper prices were firm during the first three months; the United States domestic price was 18 cents per pound, f.o.b. Connecticut.

Gold output rose 5.1 per cent to a total of 163,771 ounces from the March 1929 production of 155,810 ounces. Ontario's total was 142,952 ounces; British Columbia's 9,373 ounces; and production from Nova Scotia, Quebec, Manitoba and the Yukon accounted for the remainder.

Lead production from Ontario, British Columbia and the Yukon totalled 32,235,285 pounds or 35.1 per cent higher than the March, 1929, output. The London lead quotation for the month was 4.086 cents per pound; the Montreal price was 5.95 cents per pound.

Nickel output at 9.8 million pounds was considerably higher than the total for the corresponding month of 1929.

Silver output during March was up 17.04 per cent to a total of 1,814,997 ounces; the March, 1929, production was 1,550,356 ounces. The average New York price for silver was 41.654 cents per ounce as compared with 56.346 cents per ounce a year ago.

Zinc production continued the advance recorded during the past three months and reached a new high mark at 22,347,219 pounds. The Montreal price in March was 5.55 cents per pound in March 1929.

MINES SAFETY RESEARCH: INTERNATIONAL CO-OPERATION.

The British Government recently proposed to the Belgian Government that a scheme of co-operation in mine safety research, similar to that which was arranged in 1928 between this country and France, should operate between Great Britain and Belgium.

This proposal has been accepted, and arrangements are being made for a full interchange of information acquired by safety research in the two countries, including unpublished as well as published reports.

A similar arrangement has recently been concluded between Belgium and France, and the circle of co-operation between the three countries is therefore complete. Full co-operation in mine safety research has been effective for the past six or seven years between Great Britain and the United States.

ECONOMIC CONDITIONS IN THE NETHERLANDS.

Both local and world factors contributed to a slow but steady diminution of prosperity last year. Imports from Great Britain rose by 5 million florins, and we held third place to Germany and Belgium. The Commercial Secretary at The Hague urges the necessity for reducing production cost to make competition easier.

NETHERLANDS EAST INDIES HANDBOOK.

The Department of Overseas Trade has received from the Acting British Consul-General at Batavia a copy of the Handbook of the Netherland East Indies, 1930 edition, a useful and reliable book of reference, which has recently been published by the Division of Commerce of the Department of Agriculture, Industry and Commerce.

The Department has also received copies of two publications issued from the same Department, and entitled " The Netherland Indies "; copies of these latter publications can be consulted by interested Britishs firms on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

CHEMICALS FOR EGYPT.

The Commercial Secretary to the Residency, Egypt, reports that the Egyptian Minister of Agriculture is calling for tenders, to be presented in Cairo by the 20 July 1930, for the supply of 10 tons Calcium Arsenate; 300 tons Sulphuric Acid; 100 tons Sodium Cyanide.

Firms can obtain particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen Street, London S.W.1. Ref. No. B.X. 6603.

.OPOSED REVIVAL OF PHOSPHATE MINING IN CANADA.

:anada possesses deposits of crystalline ɔsphate of lime, or apatite, that are probly the most extensive known, Norway ng the only other country believed to poss important resources of this mineral. Anses of clean, lump Canadian apatite show to carry about 85 per cent of tricalcic osphate. It is a fluor-apatite as con-ısted with the Norwegian mineral which chlor-apatite, and it contains about 3 per ıt of fluorine.

The Canadian phosphate bodies are found two main districts, one in Quebec and the ıer in Ontario, and both near Ottawa. ıe deposits formally were systematically ned and have yielded a total recorded tput of over 300,000 tons, most of which s utilised in the manufacture of superosphate but these operations virtually ne to an end about 1895 with the disrery, in other parts of the world, of enorıus bodies of sedimentary phosphate which ıld be mined much more cheaply. Almost of the small tonnage of apatite produced Canada during the past twenty years has ɜn obtained as a by-product of micaning operations, and most of it has been lised locally in the manufacture of phosorus and fertilisers.

FUEL ECONOMY.

The annual Fuel Economy Review of the B.I. was published on Thursday, Jnne .h.

This annual publication, first started in 21, is an attempt on the part of the F.B.I. secure improved fuel practice by the disaination of up-to-date information on fuel paration and utilisation. Coal is not only ɔarently on a permanently higher price el further increases are almost certain ler the Coal Mines Bill. Fuel cost is refore becoming an increasingly import-: item in the total production costs and ess every effort is made to secure the st efficient utilisation of fuel, British lustry stands to be definitely handicapped vorld markets. The Review is addressing narily to boiler-house engineers and heatand power executives. Its scope is necırily wide as it is felt that however effic-: a particular plant may be for a particupurpose, further economies may somees be possible by a complete change of nt and fuel. Accordingly the Review cerns itself with gas, electricity and oil ıddition to coal, and also with developıts in fuel practice. Attention is also l to smoke abatement.

PROF. BRAUNER AND CZECHOSLOVAK SCIENCE.

Among the most distinguished chemists of Central Europe few are better known in England than Prof. Bohuslav Brauner of Prague University, who has recently celebrated his 75th birthday. The occasion has been marked in Czechoslovakia by the publication of a special number of the *Collection of Czechoslovak Chemical Communications* to which Prof. Brauner has himself contributed an article entitled "*D. I. Mendeleev as reflected in his Friendship to Prof. B. Brauner.*" The article is really an obituary notice of the Russian chemist who died in 1907 in his 74th year. Prof. Brauner himself did much in the 'seventies to direct scientific attention to Mendeleev's Periodic Classification of the Elements which appeared in the supplement of Liebig's *Annalen* for 1869, some years after Newlands had published his "Law of Octaves" in *The Chemical News*. Altogether over 30 of Prof. Brauner's scientific communications are related to the Periodic System, and in his present memoir he writes :

Since the beginning of the 19th century chemists related the atomic weights to two bases. After Dalton, the base was $H=1$, Berzelius on the contrary related all atomic weights to the base of oxygen. When afterwards in 1842 Dumas found the ratio of the equivalent of oxygen and hydrogen to be exactly 1 : 8. which latter leads to the ratio of atomic weights 1 : 16 simultaneously both the bases could have been accepted. Yet the experiments of Regnault (1845) and Star (1860-65) have shown the inexactness of this ratio, which was smaller, *viz.*, $H : O=1 : 15.96$ or $1.0025 : 16$; Stas proposed therefore the constant base $O=16$ and later in the year 1883 Marignac repeated this proposition.

In the year 1888 this problem became acute and my English communication where I proposed from new reasons the atomic standard $O=16$, was opportune. A great number of chemists, among then Mendeleev, Ostwald and also Venable agreed with the oxygen-base. Later Küster, Landolt, Richards and others joined them. But Lothar Meyer, Seubert, Volhard, Erdmann and Bayer with other organic chemists defended the hydrogen base. In my second discussion I proposed this decision to be left to a general vote of chemists, whereupon an international commission for atomic weights was established. This question was finally settled in 1904 in favour of the proposition which I had urged since 1888 and from that time a special committee for atomic weights

publishes every year a table of atomic weights based on $O=16$.

It is interesting that Mendeleev rejected the hydrogen base also for that reason that in his opinion elements with still lower atomic weights existed, *viz.*, "Coronium" and "Newtonium."

Another of my works was related to lead tetrafluoride. Mendeleev had predicted in 1871 that lead will form a compound with four atoms of fluorine: indeed in the year 1894 I succeeded in preparing a double salt of this exceedingly interesting substance which is also important because of the fact that it can be made to liberate free fluorine. In this manner fluorine was first obtained in a chemical way. I shall shortly mention also the works on rare earths. I always returned to this old fondness of mine realising that further progress of the Periodic System depends on the solution of the question, of what is the position of the rare earth elements. In the year 1877, when I began, the problem looked relatively simple, but after having worked at it for thirty years it seemed to grow more and more complicated.

The other articles included in this number of *Collections* are :—

J. Sterba-Böhm et Ad. Pisaricek : Sur quelques combinaisons du cérium.

J. H. Krepelka : The atomic weight of arsenic. Part I. The analysis of arsenic trichloride.

J. V. Dubsky, E .Testarik et A. Okac : Contribution a la connaissance des sels basiques, particulièrement par rapport aux sels "Ol" de cuivre.

W. P. Jorrisen : Explosive reactions and negative catalysis.

St. Skramovsky : Sur les oxalates doubles de bismuth et de sodium.

R. Uzel : Recherche microchimique de l'argent a l'état de AgN_3.

A. Simek and B. Stehlík : Melting point of pure tellurium.

W. Swietoslawski et J. Zlotowski : Sur l'application de l'ébullioscope différentiel à l'etude des melanges azéotropiques d'alcool éthylique et d'eau.

F. M. Jaeger : Molecular confiugration and optical activity.

St. Tolloczko : Equation générale de la vitesse de l'adsorption pure.

W. Kemula : Polarographic studies with the dropping mercury cathode. Part XI. Overpotential of mercury deposited from mercuric salt solutions.

K. Sandera : Polarographic studies with the dropping mercury cathode. Part XII. Investigations on the beginning of the decomposition of saccharose.

J. Heyrovsky and J. Babicka : Polarographic studies with the dropping mercury cathode. Part XIII. The effect of albumins.

V. Dolejsek : Periodicity of elements in X-ray spectra.

Marston Taylor Bogert, A. D. Hirschfelder, and P. G. I. Lauffer : Reserches in the acridine series. The synthesis of isomers of proflavine and of neutral acriflavine.

B. N. Mensutkin and M. B. Wolff : On a transformation of cyclohexane ring into that of benzene.

E. Votocek, F. Valentin et R. Rác : Etudes dans la série du rhamnose (Mannométhylose).

V. Prelog : Sur la sapogénine de la betterave a sucre.

Fr. Balas and Zd. Pejsova : On the neutral constituents of sandarac.

J. Frejka : Appareil pour l'hydrogénation catalytique.

This special issue is being sold separately for 50 Czech crowns (6s. 6d.) obtainable from Prof. Votocek, Prague II, Trojanova 13, or Prof. Heyrovsky, Prague II, Albertov 2030. The annual subscription to this journal is £1.

BOARD OF TRADE ANNOUNCEMENT

MERCHANDISE MARKS ACT, 1926.

The Board of Trade announce that they have referred to the Standing Committee appointed by them under the Merchandise Marks Act, 1926, an application for an Order in Council to require the following imported fertilisers and feeding stuffs to bear an indication of origin :—

(a) Bone meal and bone flour, whether raw, degreased or degelatinised;
(b) Hoof meal, horn meal and mixtures thereof;
(c) Meat meal, meat and bone meal and carcase meal;
(d) Dried Blood, whether ground or unground.

Representatives of any interest substantially affected by the application who desire to be heard in opposition at the public enquiry which will be held later by the Committee are requested to communicate with the Secretary, Mr. E. W. Reardon, at the Board of Trade Offices, Great George Street, London, S.W.1. as early as possible and in any case not later than the 21st July, 1930

FARADAY CENTENARY CELEBRATIONS, 1931. PROVISIONAL PROGRAMME AND DATES.

As a result of the work of the Committees a scheme for the Celebrations has been drawn up and has received the approval of the Managers of the Royal Institution and of the Council of the Institution of Electrical Engineers. The arrangements will include :—

(A) By the Royal Institution :—

(a) *Reception of Delegates* at the Royal Institution. It is intended to invite representative institutions throughout the world to send delegates to the Celebrations.

(b) A great *Faraday Commemorative Meeting* at the Queen's Hall, at which discourses will be given on Faraday's work.

(c) *Conversazione* at the Royal Institution; and other social functions.

(B) By the Institution of Electrical Engineers :—

(a) *Electrical Conferences* of the members of the Institution of Electrical Engineers, and the members of all the other Associations connected with the Electrical Industry.

(b) *Faraday Exhibition.* The central feature of the Faraday Exhibition, which it is proposed to hold in the Albert Hall, and to which the public will be admitted for a period of about ten days, Wednesday, September 23rd to Saturday October 3rd, 1931, will be reproductions, and illustrations of Faraday's actual experiments, prepared by the Royal Institution, and including a display or some of the historic apparatus. The Institution of Electrical Engineers, the Federal Council for Chemistry, and the representative organisations of the electrical and chemical industries co-operation with them, will illustrate by means of special exhibits the development of electrical and chemical science and industry in all branches which have their origin in Faraday's work. Thus will be illustrated, in a unique display, the fruition of the work of one of the world's greatest natural philosophers.

The Faraday Commemorative Meeting will be held in the Queen's Hall, and will be opened to all attending the Faraday Celebrations, including those invited by the Royal Institution and those attending the I.E.E. Conference, and the British Association meetings taking place in London at the same time. This would ensure a very large attendance.

The Exhibition will be held in the Albert Hall, which is particularly well suited for the type of exhibition proposed; it will be open to the public from about Wednesday, September 23rd, to Saturday, October 3rd.

The draft programme, with dates, which is still subject to alteration, is as follows :—

Monday, September 21st.—Afternoon : Reception of foreign and other delegates at the Royal Institution. Evening : Faraday Commemorative Meeting at the Queen's Hall.

Tuesday, September 22nd. — Morning : I.E.E. Summer Meeting begins with Joint Conference of the I.E.E. and Allied Associations. Afternoon : Visits and social functions. Evening : Conversazione by the Royal Institution. (For reasons of space only a limited number can be invited.) I.E.E. Conversazione at the Albert Hall at which the Exhibition will be opened.

Wednesday, September 23rd.—Morning : I.E.E. Summer Meeting and Conference continued. Opening of Faraday Exhibition to the public. Evening : Opening meeting of the British Association at Westminster Hall.

Following Days.—Continuation of I.E.E. Summer Meeting and British Association meetings.

The Exhibition will be managed by the British Electrical Develapment Association for, and in the name of, the Institution of Electrical Engineers, and the various associations and organisations connected with the Electrical Industry are being asked to co-operate by providing the sxhibits.

Faraday Celebrations Committees.

Called by the Royal Institution :—

The Duke of Northumberland, K.G., CB..E., M.V.O., LL.D., President, R.I.; Chairman : Sir Robert Robertson, K.B.E., M.A., F.R.S., Treasurer, R.I.; Sir William Bragg, K.B.E., LL.D., F.R.S., Director, R.I.; Mr. J. S. Highfield, M.I.C.E., M.IE.E.; Mr. Charles H. Merz, M.I.C.E., M.I.E.E.; Major C. E. S. Phillips, O.B.E., Secretary, R.I.; Sir Arthur Keith, M.D., LL.D., F.R.S.; Sir James Jeans, M.A., LL.D., F.R.S. (Royal Society); Dr. F. E.

Smith; C.B., C.B.E., F.R.S.; (British Association); Lt.-Col. K. Edgcumbe, M.I.C.E., M.I.E.E. (Institution of Electrical Engineers); Professor H. E. Armstrong, LL.D., F.R.S. (Federal Council for Chemistry); Professor T. M. Lowry, C.B.E., D.Sc., F.R.S. (Faraday Society); Major O. J. R. Howarth, O.B.E., M.A., Secretary, British Association; Mr. T. Martin, M.Sc., General Secretary, R.I.

Hospitality Sub-Committee :—

Chairman: Major C. E. S. Phillips, O.B.E.; Sir William Bragg, K.B.E., LL.D., F.R.S.; Mr. J. S. Highfield, M.I.C.E., M.I.E.E.; Col. Sir Thomas F. Purves, O.B.E., D.Sc., M.I.E.E.; Mr. L. B. Atkinson, A.M.I.C.E., M.I.E.E.; Dr. F. E. Smith, C.B., C.B.E., F.R.S.; Mr. O. J. R. Howarth, O.B.E., M.A.; Mr. Emile S. Mond.

Called by the Institution of Electrical Engineers :—

Chairman: Col. Sir Thomas F. Purves, O.B.E., D.Sc., M.I.C.E.; Commander Rollo Appleyard, O.B.E., J.P., M.I.C.E., M.I.E.E.; Mr. L. B. Atkinson, A.M.I.C.E., M.I.E.E.; Capt. J. M. Donaldson, M.C., M.I.C.E., M.I.E.E.; Mr. D. N. Dunlop, O.B.E., A.M.I.E.E.; Capt. P. P. Eckersley, M.I.E.E.; Lt.-Col. K. Edgcumbe, M.I.C.E., M.I.E.E.; Mr. H. Willoughby Ellis, A.M.I.E.E.; Mr. A. J. Fuller, M.I.E.E.; Mr. E. Leete, A.M.I.E.E.; Mr. J. T. Mould; Mr. C. C. Paterson, O.B.E., A.M.I.C.E., M.I.E.E.; Mr. F. W. Purse, M.I.E.E., M.I.Mech.E.; Mr. C. Rodgers, O.B.E., B.Sc., E.Eng., M.I.E.E.; Lt.-Col. W. A. Vignoles, D.S.O., M.I.E.E.; Mr. B. Welbourn, M.I.E.E.; Mr. A. P. Young, O.B.E., M.I.E.E.

Exhibition and Publicity Sub-Committee :—

Chairman: Lt.-Col. W. A. Vignoles, D.S.O., M.I.E.E.; Col. Sir Thomas F. Purves, O.B.E., D.Sc., M.I.E.E. (President, I.E.E.); Mr. H. Willoughby Ellis, A.M.I.E.E.; Mr. J. T. Mould; Mr. C. Rodgers, O.B.E., B.Sc., B.Eng., M.I.E.E.; Sir William Bragg, K.B.E., F.R.S. (Director, R.I.); Sir Robert Robertson, K.B.E., F.R.S. (Treasurer, R.I.); Professor H. E. Armstrong, LL.D., F.R.S.; W. G. Plummer, M.Sc., Ph.D.; Commander Rollo Appleyard, O.B.E., J.P., M.I.C.E., M.I.E.E.; Mr. A. P. Young, O.B.E., M.I.E.E.; Mr. T. Martin, M.Sc.; Mr. P. F. Rowell, Mr. C. Holmes Waghorn,

UNIVERSITY OF LONDON, SCHOOL OF LIBRARIANSHIP.

Diploma for Special Librarians.

During the last decade or two, there has been a rapid growth in the number of what are called "Special Libraries." Many of these are not libraries in the ordinary sense, but consist largely of such *abiblia*—to use Charles Lamb's term—as periodicals and other records of the latest research. Thousands of such periodicals are now coming in from every quarter of the globe, and the digesting and indexing of these requires scientific and technical knowledge and familiarity with many languages. Special libraries are an important organ in the research departments and information bureaux attached to the large technical and industrial corporations and also to the great scientific and other learned societies. To train competent librarians to run them is an urgent problem, which has been anxiously considered by ASLIB (Association of Special Libraries and Information Bureaux) and also by the School of Librarianship at University College, London.

The School of Librarianship has just prepared a scheme which has been passed by the Senate of the University of London to enable graduates in Science to receive a suitable course of training in one session, and attain the Diploma of Librarianship on conditions similar to those allowed to other University graduates.

The present curriculum stands good for every type of librarian, but certain alternatives have now been introduced for the benefit of those who wish to become special librarians. The separate subjects Library Organisation and Library Routine have been modified and combined into the new subject Library Economy (omitting those features peculiar to Public Library administration): the History of Science is given as an alternative to Palaeography and Archives; and a new subject Special Library Services dealing with the point of view and the scope of special libraries and information bureaux has been introduced.

These Regulations come into force at once and a course of instruction is being provided for the session beginning in October 1930, when the new courses will start, provided that a fair number of persons desiring to train for work in special libraries enrol themselves before the middle of July. Further information can be obtained from the Secret-

Proceedings and Notices of Societies

THE ROYAL SOCIETY.

Thursday, June 19.

The following papers were read :—

New Results of the Magnetic Spectroscopy of X-ray Electrons. By H. R. Robinson, F.R.S., and C .L. Young.

New measurements are given of the energies and intensities of the secondary, tertiary, . . . cathode rays ejected by silver K-radiations from a number of elements. The results are discussed in their relation to current theories of the interaction of X-rays and matter and of the X-ray term structnre.

Photo-Conductance Phenomena in the Silver Halides and Latent Photographic Image. By F .C. Toy and G. B. Harrison. Communicated by T. Slater Price, F.R.S.

The Optical Determination of High Metallurgical Temperatures. The Melting Point of Iron. By C. H. M. Jenkins and M. L. V. Gayler. Communicated by W. Rosenhain, F.R.S.

THE CHEMICAL SOCIETY.

Thursday, June 19.

The Constitution of Some Organic Derivatives of Thallium. By N. V. Sidgwick and L. E. Sutton.

The molecular weights of several aliphatic and aromatic thallous alkoxides have been examined in benzene solution, and in each case ready association to a stable four-fold polymeride has been observed. The ethoxide was also quadrimolecular in ethyl alcohol, although the methoxide was unimolecular in methyl alcohol (at the boiling-points). Two possible constitutions for the polymeride have been suggested and discussed.

Thallo-acetoacetic ester was found to associate readily, in benzene solution, to a bimolecular complex for which also two possible structures were sugegsted, one resembling one of those for the quadrimolecular complex.

The bearing of these results on the parachors of thallium compounds, and deductions therefrom, is discussed.

The Constitution of Complex Metallic Salts. By F. G. Mann.

Attempts have been made to confirm the assumption that in the metallic ammines and similar complex salts, the co-ordinated molecules are united to the central metallic atom by a "semi-polar double bond," or a "co-ordinate link." A salt of the type of potassium platinomethyl-ethyl-sulphide trichloride, K[Pt←SMeEtCl$_3$], should thus be capable of resolution into optically active forms, being stereochemically equivalent to methyl-ethyl-sulphoxide, O←SMeEt.

A number of such compounds has been prepared, and, finally, tetrachloro-($\beta\beta'$-diamino - diethyl - sulphide - mono - hydro - chloride)-platinum has been obtained, having $[M]_{5461} = 1100°$. In this compound the platinic complex is of the neutral, non-ionic type, but the second amino-group, being unco-ordinated, forms salts with acids. The dissymmetry is here due to the sulphur atom becoming asymmetric by co-ordination with the platinum atom, and the resolution provides decisive evidence of a covalent linking of fixed direction between these two atoms.

The Optical Resolution of 2 : 4-dinitro-2'-Methyldiphenyl-6-Carboxylic Acid. By Miss M. S. Lesslie and E. E. Turner.

The *acid* mentioned in the title has been obtained in the optically pure *d*- and *l*-forms, whilst 2 : *4-dinitro-3'-methyldiphenyl 6-carboxylic acid* and 2 : *4-dinitrophenyl-6-carboxylic acid* could not be resolved. The significance of these results was discussed.

The Scission of Diaryl Ethers and Related Compounds by means of piperidine. Part V. The nitration of methyl-, dimethyl-, and polyhalogeno-derivatives of diphenyl ether. By Miss D. L. Fox and E. E. Turner.

In continuation of previous work, the nitration of a number of derivatives of diphenyl ether, containing one or more methyl radicals, and halogen atoms, has been investigated. The more highly substituted halogeno-ethers are nitrated readily and, in general, do not tend to lose halogen atoms. Further irregularities in substitution reactions have, however, been observed.

Structure of isonitriles and compounds of bivalent carbon. By D. Ll. Hammick, R. G. A. New, N. V. Sidgwick, and L. E. Sutton.

A NEW TYPE OF ENVELOPE.

The number of catalogues lost or damaged through being posted in insecure envelopes is serious. This has led John Thomlinson, Ltd., of Glasgow, to introduce an envelope that gives complete security. Known as the "Bontuk," it is now being extensively used by many large houses in Britain. It complies fully with postal regulations, is quickly filled and closed, and the contents cannot accidentally come out.

NOTICES OF BOOKS.

Chemistry for Beginners. By E. J. HOLMYARD, M.A., M.Sc., D.Litt., F.I.C. Pp. X + 223. London: J. M. Dent and Sons. 1930. Price 2s. 6d.

All books by Dr. Holmyard—and this one is no exception—are written in such a refreshing and stimulating style that they immediately commend themselves to science masters and others engaged in teaching chemistry. Moreover, the pupils themselves —especially young beginners—find particular pleasure in Dr. Holmyard's manner of presenting the subejct. Their first queries are answered but their further curiosity is so aroused that they consequently develop a keen interest for science in general.

Chemistry for Beginners is intended as a class book for young pupils, although much of the text is equally well suited for study by older students who are beginners. In this respect the chapters on Oxygen, Hydrogen, Water, and Acids, Bases and Salts are especially noteworthy. The account, in the chapter on Oxygen, of the explanation of combustion and the parallel explanations of various experimental results by "phlogistians" and by Lavoisier is particularly lucid and valuable.

The exact significance of formulæ and equations are given in an eminently readable chapter entitled "Chymistry no Mystery." These are typical of the whole book, which should indeed prove of great service to students and to science masters and lecturers on elementary chemistry.

J. G. F. D.

Schmiermittel. By C. WALTHER. Pp. X + 144. Dresden and Liepzig. Theodor Steinkopff. 1930. Price 11 marks.

A lubricating substance must be able to diminish considerably the friction between two metal surfaces and at the same time must not appreciably attack or chemically affect the metals. With the rapid development of the motor industry and use of powerful machinery in electrical installations, the subject of lubrication has become one of considerable importance and lubricants can no longer be regarded as the waste products of oil-refining processes or soap making.

The present volume is descriptive of the essential qualities to be possessed by satisfactory lubricants for various purposes, their preparation and chemical examination and the modes of analytical procedure followed in testing lubricating oils.

Among the more recent sources of lubricating oils are the residues from the distillation of coal tar oils and the regeneration of used oils has attained some significance. The use of graphite, either alone or as a colloidal oil emulsion, it would seem, is not so extensive as formerly.

The book (vol. xxiii of the Technical Monographs edited by Prof. B. Rassow of Leipzig) is written by a chemical engineer and should prove of considerable interest to all concerned with lubricating problems.

Modern Physical Chemistry. By F. H. CONSTABLE, M.A., D.Sc., F.I.C., F.Inst.P. Pp. 157. London: Ernest Benn, Bouverie House, Fleet St., E.C. 1930. Price 10s. 6d.

This condensed outline of physical chemistry is intended primarily for students reading for University degree examinations but may also be used with advantage in advanced school courses in physical chemistry.

The whole subject is well covered, including recent developments and some knowledge of mathematics is issumed. Upon the major part of the book nothing but praise can be bestowed, but the section on Thermochemistry is rather weak. Indeed no mention is made of Thomsen's work and Berthelot is also not referred to. The sections on Catalysis and Colloids are very well done and give the non-specialist a clear account of the recent growth of these subjects.

The ever-widening field of modern science renders it increasingly necessary that science books should present the subject concisely and yet afford the general reader a clear outlook covering the whole field. In the present volume this has been carefully borne in mind by the author.

Alcoholometry. (An Account of the British Method of Alcoholic Strength Determination with an Historical Introduction written in collaboration with GEORGE H. GABB). By FRANCIS G. H. TATE. Pp. xviii + 93 + 12 plates. London: H. M. Stationery Office, Adastral House, Kingsway, W.C. 1930. Price 5s.

This interesting monograph on Alcoholometry has been written by Mr. F. G. H. Tate of H.M. Customs and Excise Dept.,

account of the uncertainty that has [hi]therto existed on the subject of the official [ba]sis of hydrometry laid down by Sikes, [wh]ose methods remained in force during the [wh]ole of last century. The original records [an]d Sikes' calculations are now published for [th]e first time and it is seen that the evolu[tio]n of the hydrometer used has been closely [as]sociated with the definition of that [st]rength of alcohol known as "proof spirit."

The origin of the art of distilling alcohol is [lo]st in the remote past. It is definitely re[fe]rred to in the earliest chemical writings. [Th]e consumption of whisky, brandy and [ot]her spirits in Britain is recorded in the [M]iddle Ages and "State control" set in at [th]e time of the Commonwealth. Attempts [to] fix duties on the value of the alcoholic [co]ntent were made in the early eighteenth [ce]ntury and the foundations of the present [sy]stem arose from the Committee of [E]nquiry appointed in 1802. The hydro[m]eter designed by Bartholomew Sikes was [th]at finally selected for use with the tables [th]e prepared for the purpose. This system [w]as legalised in 1816 and remained in force [un]til 1907. In the meanwhile criticism had [be]en levelled at the tables and more accurate [da]ta were compiled concerning the specific [gr]avity of alcohol-water mixtures and the [in]fluence of temperature upon the specific [gr]avity of such mixtures. Thus in January, [18]65, D. I. Mendeléef published in St. [Pe]tersburg (Leningrad) exhaustive tables [wh]ich he had compiled from actual measure[m]ents, which as Prof. B. Brauner has [re]cently written (*Collection of Czecho[slo]vak Chemical Communications*, 1930, II, 228) "were determined with an exactness [hi]therto unsurpassed and his tables were [ad]opted for excise purposes in all coun[tri]es." The specific gravities were measured [in] a pyknometer which Mendeléef specially [de]signed for the purpose.

In 1907 the new British Customs and [Re]venue regulations were enacted and the [ta]bles compiled under the direction of Sir [T.] E. Thorpe came into use. The present [wo]rk on Alcoholometry concludes with [ch]apters on the standardisation of hydro[me]ters, "obscuration," and the refracto[me]ter.

The historical introduction and the de[scr]iptions of the early apparatus have been [wr]itten in collaboration with Mr. G. H. [Ga]bb, the well-known authority and collec[tor] of early scientific apparatus.

PUBLICATIONS RECEIVED.

U.S. Geological Survey.

Surface Water Supply of the United States. 1925. Part I. North Atlantic Slope Drainage Basins. By N. C. Grover. Paper 601. Price 30 cents.

Surface Water Supply of the United States. 1925. Part 2. Hudson Bay and Upper Mississippi River Basins. By N. C. Grover. Paper 605. Price 25 cents.

Upper Colorado River and its Utilisation. By Robert Follansbee. Paper 617. Price 65 cents.

The New England Flood of November, 1927. By H. B. Kinnison. Paper 636-c.

Surface Water Supply of the San Joaquin River Basin, California, 1895-1927. By H. D. McGlashan. Paper 636D. Price 10 cents.

Surface Water Supply of Pacific Slopes Basins in Southern California, 1894-1927. By H. D. McGlashan. Paper 636E. Price 10 cents.

Indiana Oolitic Limestone. Relations of its Natural Features to its Commercial Grading. By G. F. Loughlin. Bulletin 811-C. Price 30 cents.

The Rawlins, Sirley, and Seminoe Iron-Ore Deposits, Carbon County, Wyoming. By T. S. Lovering. Bulletin 811-D Price 10 cents.

The Granby Anticline Grand County, Colorado. By T. S. Lovering. Bulletin 822-B. Price 5 cents.

Tertiary Volcanic Tuffs and Sandstones Used as Building Stones in the Upper Salmon River Valley, Idaho. By C. H. Behre, Jr. Bulletin 811-E. Price 10 cents.

State of Connecticut Public Document No. 24. Fifty-Second Report of the Con-New Haven. For the year 1928.

Forthcoming Events

ROYAL INSTITUTION.

21, Albemarle Street, London, W.1.

Monday, July 7, at 5 p.m.—General Meeting.

New Patents.

These particulars of New Patents of interest to Readers have been selected from the Official Journal of Patents, and are published by special permission of the Controller of His Majesty's Stationery Office.

Latest Patent Applications.

16,997.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of hydrogen peroxide. June 2.

17,061.—I. G. Farbenindustrie Akt.-Ges. — Manufacture of bis-(halogen-hydroxy-aryl)-sulphides. June 2.

17,543.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of dyestuffs of the anthraquinone series. June 6.

17,039.—Institut fur Physikalische Grundlagen der Medizin.—Carrying out chemical synthesis. June 2.

Specifications Published.

306,963.—I. G. Farbenindustrie Akt.-Ges. —process for the manufacture of anthraquinone derivatives.

330,026.—Soc. Anon. des Distilleries des Deux-Sevres.—Extraction of acetic acid from pyroligneous acid.

308,666.—I. G. Farbenindustrie Akt.-Ges. —Manufacture of carboxylic acid halides.

Printed copies of the full published specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2., at the uniform price of 1/- each.

Abstract Published.

328,029.—Nitrogen peroxide.—I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany.

Nitrogen peroxide in liquid form is prepared from gases containing lower oxides in dilute form such as those obtained by the catalytic oxidation of ammonia or nitrogen by converting the lower oxides into compounds such as nitrites, nitrates or nitrosyl compounds, from which they are liberated in concentrated form as nitric oxide which is mixed with oxygen to form nitrogen peroxide. A solution of nitrites obtained by absorption of the gases in alkali or alkaline earth compounds may be decomposed by treatment with nitric acid, and solutions of nitrates or nitrosyl chloride by reaction of the acidified solution with reducing agents, such as with sulphur dioxide at 70-80° C. or with coal or other carbonaceous substance at the boiling point.

A NEW TYPE CLUTCH.

We have received from Hans Renold, Ltd., Manchester, particulars of new clutches which, though on an entirely new principle, are extremely simple in construction, efficient and cheap to instal.

They provide an equivalent of the fast and loose pulley for chain drives.

They are of minimum weight for maximum power.

They are capable of quick or gradual engagement.

They have no springs or lining, and

They will run in oil.

GENERAL INDEX TO THE "CHEMICAL NEWS"—VOLS. 1 TO 100.

This large volume contains a detailed Index to the first 100 volumes of the *Chemical News*, and will be found of great value to all interested in Chemical, Engineering, Electrical and General Scientific subjects. It has been compiled with great care, is handsomely bound in red cloth, and has been produced at great expenditure of time, labour and money. Carriage paid, Great Britain, 21/- net; Carriage paid to Foreign Countries and the Colonies, 23/- net.

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